

FEMA P-58 Fragility Specification

NISTIR Classification B1031.001
NISTIR Name Bolted shear tab gravity connections
Description Costing is on a per connection basis. Costing does not include fireproofing removal or reapplication cost.

Line 1

Construction Quality:	Not Specified					<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	EA 1					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	4					
Damage State:	DS1	DS2	DS3	DS4		
Type of Damage State:	Mutually Exclusive		Mutually Exclusive	Sequential	Sequential	
DS Hierarchy	Seq(MutEx(DS1,DS2),DS3,DS4)					
Descriptions	Yielding of shear tab and elongation of bolt holes, possible crack initiation around bolt holes or at shear tab weld. Damage in field is either obscured or deemed to not warrant repair. No repair conducted.		Yielding of shear tab and elongation of bolt holes, possible crack initiation around bolt holes or at shear tab weld.		Partial tearing of shear tab and possibility of bolt shear failure (6-bolt or deeper connections).	Complete separation of shear tab, close to complete loss of vertical load resistance.

Illustrations



Damage State Probability:	0.95	0.05	1.00	1.00	
Fragility Parameters					
Median Demand, θ :	0.04	0.04	0.08	0.11	
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified	Not Specified	
Uncertainty, β_u :	0.4	0.4	0.4	0.4	
Total Dispersion, β :	0.4	0.4	0.4	0.4	
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Superior		Rationality Superior	

Consequence Functions
Repair Description

Careful inspection and welded repair to any cracks and possible replacement of shear tab if bolt hole deformations are excessive (possible for deeper 6-bolt or deeper shear tabs). Field condition is deemed to not warrant repair by field observation. This Damage State is Mutually Exclusive with DS2. See fragility DS1 and DS2 probabilities.

Careful inspection and welded repair to any cracks and possible replacement of shear tab if bolt hole deformations are excessive (possible for deeper 6-bolt or deeper shear tabs).

Repairs will include either welded repair of shear tab or possible complete replacement of shear tab and installation of new bolts. Repairs may require shoring of beam.

Repair will include complete replacement of shear tab and installation of new bolts. Repairs will require shoring of beam.

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	0.00E+00	0.00E+00	0.00E+00	6.05E+03	1.27E+04	1.76E+04	6.05E+03	1.30E+04	1.81E+04	6.05E+03	1.27E+04	1.82E+04			
Best fit mean:	0.00E+00			1.21E+04			1.24E+04			1.23E+04					
Best Fit Distribution:	LogNormal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	0.00E+00 0.00E+00			1.65E+04 1.02E+04			1.56E+04 1.10E+04			1.53E+04 1.08E+04					
CV or beta (Min Qty, Max Qty)	0.25 0.25			0.37 0.37			0.38 0.38			0.38 0.38					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	0.00E+00	0.00E+00	0.00E+00	5.87E+00	1.23E+01	1.70E+01	5.87E+00	1.26E+01	1.75E+01	5.87E+00	1.23E+01	1.76E+01			
Best fit mean:	0.00E+00			1.18E+01			1.20E+01			1.19E+01					
Best Fit Distribution:	LogNormal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	0.00E+00 0.00E+00			1.60E+01 9.88E+00			1.51E+01 1.07E+01			1.48E+01 1.05E+01					
CV or beta (Min Qty, Max Qty)	0.35 0.35			0.45 0.45			0.45 0.45			0.46 0.46					
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	0.0E+00	LogNormal	0.35	1.4E+03	Normal	0.45	1.4E+03	Normal	0.45	1.8E+03	Normal	0.46			
Embodied Energy (MJ)	0.0E+00	LogNormal	0.35	1.9E+04	Normal	0.45	2.0E+04	Normal	0.45	3.2E+04	Normal	0.46			
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			NO			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			20% 0.50			10% 0.50					

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Greg Deierlein
Revisions: 2016-06-27 Revise DS1 to be MutEx zero cost version of itself.

Root Cost Multiplier: 1
Date Generated: 02/26/19

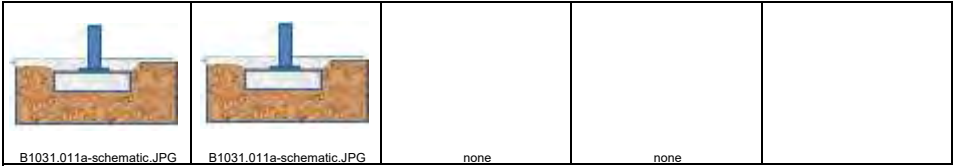
FEMA P-58 Fragility Specification

NISTIR Classification B1031.011a
NISTIR Name Steel Column Base Plates, Column W < 150 plf
Description Costing is on a per connection basis. Costing does not include fireproofing removal or reapplication cost.

Line 2

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Mutually Exclusive		Mutually Exclusive		
DS Hierarchy	Seq(MutEx(DS1,DS2),DS3,DS4)				
Descriptions	Initiation of crack at the fusion line between the column flange and the base plate weld. Damage in field is either obscured or deemed to not warrant repair. No repair conducted.		Initiation of crack at the fusion line between the column flange and the base plate weld.		Propagation of brittle crack into column and/or base plate.
					Complete fracture of the column (or column weld) and dislocation of column relative to the base.

Illustrations



Damage State Probability:	0.95	0.05	1.00	1.00	
Fragility Parameters					
Median Demand, θ :	0.04	0.04	0.07	0.1	
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified	Not Specified	
Uncertainty, β_u :	0.4	0.4	0.4	0.4	
Total Dispersion, β :	0.4	0.4	0.4	0.4	
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Superior		Rationality Superior	

Consequence Functions
Repair Description

The repair will involve removal of a portion of grade slab, gouging out material surrounding the fracture initiating and re-welding, then repair of slab. Field condition is deemed to not warrant repair by field observation. This Damage State is Mutually Exclusive with DS2. See fragility DS1 and DS2 probabilities.

The repair will involve removal of a portion of grade slab, gouging out material surrounding the fracture initiating and re-welding, then repair of slab.

Depending on the crack trajectory, the repair will range from replacement of a portion of the column or base plate to full replacement of the column base. Replacement will require shoring of column, torch cutting to remove damaged material, and fabrication and field welding to install replacement material.

Repair would likely involve replacing the entire base plate assembly and most of the column in the story above the base plate.

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	0.00E+00	0.00E+00	0.00E+00	1.12E+04	1.95E+04	3.23E+04	1.79E+04	2.62E+04	4.39E+04	2.23E+04	3.06E+04	5.09E+04			
Best fit mean:	0.00E+00			1.92E+04			2.73E+04			3.24E+04					
Best Fit Distribution:	LogNormal			LogNormal			LogNormal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00			5.00					
Average Repair Cost (Min Qty, Max Qty)	0.00E+00			2.54E+04			3.15E+04			3.67E+04			2.60E+04		
CV or beta (Min Qty, Max Qty)	0.25			0.41			0.37			0.34			0.34		
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	0.00E+00	0.00E+00	0.00E+00	1.08E+01	1.89E+01	3.14E+01	1.74E+01	2.54E+01	4.26E+01	2.16E+01	2.97E+01	4.94E+01			
Best fit mean:	0.00E+00			1.87E+01			2.65E+01			3.15E+01					
Best Fit Distribution:	LogNormal			LogNormal			LogNormal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00			5.00					
Average Repair Time (Min Qty, Max Qty)	0.00E+00			2.46E+01			3.05E+01			3.57E+01			2.53E+01		
CV or beta (Min Qty, Max Qty)	0.35			0.48			0.44			0.42			0.42		
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	0.0E+00	LogNormal	0.35	4.2E+03	LogNormal	0.48	5.9E+03	LogNormal	0.44	1.0E+04	LogNormal	0.42			
Embodied Energy (MJ)	0.0E+00	LogNormal	0.35	5.6E+04	LogNormal	0.48	1.0E+05	LogNormal	0.44	1.5E+05	LogNormal	0.42			
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00				
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00				
Post-event Tagging Flag:	NO			NO			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		25%	0.50		10%	0.50				

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Greg Deierlein
Revisions: 2016-06-27 revise DS1 to be MutEx zero cost version of itself.

Root Cost Multiplier: 1
Date Generated: 02/26/19

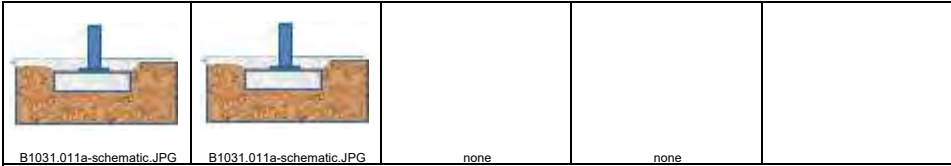
FEMA P-58 Fragility Specification

NISTIR Classification B1031.011b
NISTIR Name Steel Column Base Plates, Column 150 plf < W < 300 plf
Description Costing is on a per connection basis. Costing does not include fireproofing removal or reapplication cost.

Line 3

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift RatioUnit less				
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Mutually Exclusive		Mutually Exclusive		
DS Hierarchy	Seq(MutEx(DS1,DS2),DS3,DS4)				
Descriptions	Initiation of crack at the fusion line between the column flange and the base plate weld. Damage in field is either obscured or deemed to not warrant repair. No repair conducted.		Initiation of crack at the fusion line between the column flange and the base and/or base plate. Propagation of brittle crack into column and/or base plate.		Complete fracture of the column (or column weld) and dislocation of column relative to the base.

Illustrations



Damage State Probability:	0.95	0.05	1.00	1.00	
Fragility Parameters					
Median Demand, θ :	0.04	0.04	0.07	0.1	
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified	Not Specified	
Uncertainty, β_u :	0.4	0.4	0.4	0.4	
Total Dispersion, β :	0.4	0.4	0.4	0.4	
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Superior		Rationality Superior	

Consequence Functions
Repair Description

The repair will involve removal of a portion of grade slab, gouging out material surrounding the fracture initiating and re-welding, then repair of slab. Field condition is deemed to not warrant repair by field observation. This Damage State is Mutually Exclusive with DS2. See fragility DS1 and DS2 probabilities.

The repair will involve removal of a portion of grade slab, gouging out material surrounding the fracture initiating and re-welding, then repair of slab.

Depending on the crack trajectory, the repair will range from replacement of a portion of the column or base plate to full replacement of the column base. Replacement will require shoring of column, torch cutting to remove damaged material, and fabrication

Repair would likely involve replacing the entire base plate assembly and most of the column in the story above the base plate.

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	0.00E+00	0.00E+00	0.00E+00	1.20E+04	2.03E+04	3.31E+04	1.99E+04	2.82E+04	4.59E+04	2.63E+04	3.46E+04	5.49E+04			
Best fit mean:	0.00E+00			2.01E+04			2.94E+04			3.67E+04					
Best Fit Distribution:	LogNormal			LogNormal			LogNormal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00			5.00			20.00		
Average Repair Cost (Min Qty, Max Qty)	0.00E+00			2.64E+04			3.39E+04			4.15E+04			2.94E+04		
CV or beta (Min Qty, Max Qty)	0.25			0.39			0.34			0.31			0.31		
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	0.00E+00	0.00E+00	0.00E+00	8.80E+00	1.49E+01	2.43E+01	1.46E+01	2.08E+01	3.38E+01	1.93E+01	2.55E+01	4.04E+01			
Best fit mean:	0.00E+00			1.48E+01			2.16E+01			2.70E+01					
Best Fit Distribution:	LogNormal			LogNormal			LogNormal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00			5.00			20.00		
Average Repair Time (Min Qty, Max Qty)	0.00E+00			1.94E+01			2.49E+01			3.05E+01			2.16E+01		
CV or beta (Min Qty, Max Qty)	0.35			0.46			0.42			0.39			0.39		
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	0.0E+00	LogNormal	0.35	4.3E+03	LogNormal	0.46	1.9E+02	LogNormal	0.42	3.9E+02	LogNormal	0.39			
Embodied Energy (MJ)	0.0E+00	LogNormal	0.35	5.8E+04	LogNormal	0.46	5.9E+03	LogNormal	0.42	1.2E+04	LogNormal	0.39			
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00				
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00				
Post-event Tagging Flag:	NO			NO			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		25%	0.50		10%	0.50				

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Greg Deierlein
Revisions: 2016-06-27 revise DS1 to be MutEx zero cost version of itself.

Root Cost Multiplier: 1
Date Generated: 02/26/19

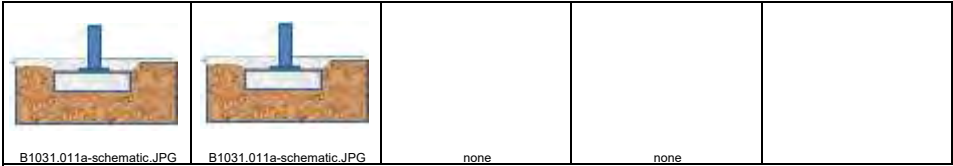
FEMA P-58 Fragility Specification

NISTIR Classification B1031.011c
NISTIR Name Steel Column Base Plates, Column W > 300 plf
Description Costing is on a per connection basis. Costing does not include fireproofing removal or reapplication cost.

Line 4

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Mutually Exclusive		Mutually Exclusive		
DS Hierarchy	Seq(MutEx(DS1,DS2),DS3,DS4)				
Descriptions	Initiation of crack at the fusion line between the column flange and the base plate weld. Damage in field is either obscured or deemed to not warrant repair. No repair conducted.		Initiation of crack at the fusion line between the column flange and the base plate weld.		Propagation of brittle crack into column and/or base plate.
					Complete fracture of the column (or column weld) and dislocation of column relative to the base.

Illustrations



Damage State Probability:	0.95	0.05	1.00	1.00	
Fragility Parameters					
Median Demand, θ :	0.04	0.04	0.07	0.1	
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified	Not Specified	
Uncertainty, β_u :	0.4	0.4	0.4	0.4	
Total Dispersion, β :	0.4	0.4	0.4	0.4	
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Superior		Rationality Superior	

Consequence Functions
Repair Description

The repair will involve removal of a portion of grade slab, gouging out material surrounding the fracture initiating and re-welding, then repair of slab. Field condition is deemed to not warrant repair by field observation. This Damage State is Mutually Exclusive with DS2. See fragility DS1 and DS2 probabilities.

The repair will involve removal of a portion of grade slab, gouging out material surrounding the fracture initiating and re-welding, then repair of slab.

Depending on the crack trajectory, the repair will range from replacement of a portion of the column or base plate to full replacement of the column base. Replacement will require shoring of column, torch cutting to remove damaged material, and fabrication

Repair would likely involve replacing the entire base plate assembly and most of the column in the story above the base plate.

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	0.00E+00	0.00E+00	0.00E+00	1.32E+04	2.15E+04	3.43E+04	2.29E+04	3.12E+04	4.89E+04	3.13E+04	3.96E+04	5.99E+04			
Best fit mean:	0.00E+00			2.14E+04			3.26E+04			4.19E+04					
Best Fit Distribution:	LogNormal			LogNormal			LogNormal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00			5.00			20.00		
Average Repair Cost (Min Qty, Max Qty)	0.00E+00			2.80E+04			3.75E+04			4.75E+04			3.37E+04		
CV or beta (Min Qty, Max Qty)	0.25			0.37			0.31			0.27			0.27		
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	0.00E+00	0.00E+00	0.00E+00	8.72E+00	1.42E+01	2.27E+01	1.51E+01	2.07E+01	3.24E+01	2.07E+01	2.62E+01	3.97E+01			
Best fit mean:	0.00E+00			1.41E+01			2.16E+01			2.77E+01					
Best Fit Distribution:	LogNormal			LogNormal			LogNormal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00			5.00			20.00		
Average Repair Time (Min Qty, Max Qty)	0.00E+00			1.85E+01			2.48E+01			3.15E+01			2.23E+01		
CV or beta (Min Qty, Max Qty)	0.35			0.45			0.40			0.37			0.37		
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	0.0E+00	LogNormal	0.35	4.4E+03	LogNormal	0.45	4.8E+02	LogNormal	0.40	8.7E+02	LogNormal	0.37			
Embodied Energy (MJ)	0.0E+00	LogNormal	0.35	6.1E+04	LogNormal	0.45	1.5E+04	LogNormal	0.40	2.7E+04	LogNormal	0.37			
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00				
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00				
Post-event Tagging Flag:	NO			NO			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		25%	0.50		10%	0.50				

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Greg Deierlein
Revisions: 2016-06-27 revise DS1 to be MutEx zero cost version of itself.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification B1031.021a
NISTIR Name Welded column splices, Column W < 150 plf
Description Costing is on a per connection basis. Costing does not include fireproofing removal or reapplication cost.

Line 5

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Mutually Exclusive		Sequential		
DS Hierarchy	Seq(MutEx(DS1,DS2),DS3)				
Descriptions	Ductile fracture of the groove weld flange splice. Damage in field is either obscured or deemed to not warrant repair. No repair conducted.	Ductile fracture of the groove weld flange splice.	DS1 followed by complete failure of the web splice plate and dislocation of the two column segments on either side of the splice.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	0.95	0.05	1.00		
Fragility Parameters					
Median Demand, θ :	0.02	0.02	0.05		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	0.4	0.4	0.4		
Total Dispersion, β :	0.4	0.4	0.4		
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Superior		Rationality Superior	

Consequence Functions

Repair Description	Repair would involve gouging out the material adjacent to the fracture and repairing with a new groove weld. Field condition is deemed to not warrant repair by field observation. This Damage State is Mutually Exclusive with DS2. See fragility DS1 and DS2 probabilities.	Repair would involve gouging out the material adjacent to the fracture and repairing with a new groove weld.	Repair may not be practically feasible, but would require either realignment or replacement of adjacent column segments and rewelding of splice.
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Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	0.00E+00	0.00E+00	0.00E+00	5.57E+03	9.34E+03	1.34E+04	7.57E+03	1.13E+04	1.65E+04						
Best fit mean:	0.00E+00			9.45E+03			1.12E+04								
Best Fit Distribution:	LogNormal			Normal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	0.00E+00 0.00E+00			1.21E+04 7.47E+03			1.36E+04 9.64E+03								
CV or beta (Min Qty, Max Qty)	0.25 0.25			0.32 0.32			0.30 0.30								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	0.00E+00	0.00E+00	0.00E+00	5.40E+00	9.07E+00	1.30E+01	7.34E+00	1.10E+01	1.60E+01						
Best fit mean:	0.00E+00			9.17E+00			1.09E+01								
Best Fit Distribution:	LogNormal			Normal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	0.00E+00 0.00E+00			1.18E+01 7.25E+00			1.32E+01 9.36E+00								
CV or beta (Min Qty, Max Qty)	0.35 0.35			0.41 0.41			0.39 0.39								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	0.0E+00	LogNormal	0.35	1.0E+03	Normal	0.41	1.0E+03	LogNormal	0.39						
Embodied Energy (MJ)	0.0E+00	LogNormal	0.35	1.7E+04	Normal	0.41	1.7E+04	LogNormal	0.39						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		2%	0.50							

Comments: from weld root area.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Greg Deierlein
Revisions: 2015-07-28 revise DS1 and DS2 description and repair to align with FEMA P-38 BD-3.8.3 Page 23. 2016-06-27 Revise DS1 to be MutEx zero cost version of itself.
Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification B1031.021b
NISTIR Name Welded column splices, Column 150 plf < W < 300 plf
Description Costing is on a per connection basis. Costing does not include fireproofing removal or reapplication cost.

Line 6

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Mutually Exclusive		Sequential		
DS Hierarchy	Seq(MutEx(DS1,DS2),DS3)				
Descriptions	Ductile fracture of the groove weld flange splice. Damage in field is either obscured or deemed to not warrant repair. No repair conducted.	Ductile fracture of the groove weld flange splice.	DS1 followed by complete failure of the web splice plate and dislocation of the two column segments on either side of the splice.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	0.95	0.05	1.00		
Fragility Parameters					
Median Demand, θ :	0.02	0.02	0.05		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	0.4	0.4	0.4		
Total Dispersion, β :	0.4	0.4	0.4		
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Superior		Rationality Superior	

Consequence Functions
Repair Description

Repair would involve gouging out the material adjacent to the fracture and repairing with a new groove weld. Field condition is deemed to not warrant repair by field observation. This Damage State is Mutually Exclusive with DS2. See fragility DS1 and DS2 probabilities.

Repair would involve gouging out the material adjacent to the fracture and repairing with a new groove weld.

Repair may not be practically feasible, but would require either realignment or replacement of adjacent column segments and rewelding of splice.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	0.00E+00	0.00E+00	0.00E+00	6.37E+03	1.01E+04	1.42E+04	8.37E+03	1.33E+04	1.73E+04						
Best fit mean:	0.00E+00			1.02E+04			1.30E+04								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	0.00E+00 0.00E+00			1.32E+04 8.11E+03			1.60E+04 1.13E+04								
CV or beta (Min Qty, Max Qty)	0.25 0.25			0.30 0.30			0.27 0.27								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	0.00E+00	0.00E+00	0.00E+00	4.68E+00	7.46E+00	1.05E+01	6.15E+00	9.81E+00	1.27E+01						
Best fit mean:	0.00E+00			7.53E+00			9.57E+00								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	0.00E+00 0.00E+00			9.69E+00 5.96E+00			1.18E+01 8.34E+00								
CV or beta (Min Qty, Max Qty)	0.35 0.35			0.39 0.39			0.37 0.37								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	0.0E+00	LogNormal	0.35	7.7E+01	Normal	0.39	1.9E+02	Normal	0.37						
Embodied Energy (MJ)	0.0E+00	LogNormal	0.35	2.4E+03	Normal	0.39	5.9E+03	Normal	0.37						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		2%	0.50							

Comments: from weld root area.

Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Greg Deierlein
Revisions: 2015-07-28 revise DS1 and DS2 description and repair to align with FEMA P-38 BD-3.8.3 Page 23. 2016-06-27 Revise DS1 to be MutEx zero cost version of itself.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification B1031.021c
NISTIR Name Welded column splices, Column W > 300 plf
Description Costing is on a per connection basis. Costing does not include fireproofing removal or reapplication cost.

Line 7

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Mutually Exclusive		Sequential		
DS Hierarchy	Seq(MutEx(DS1,DS2),DS3)				
Descriptions	Ductile fracture of the groove weld flange splice. Damage in field is either obscured or deemed to not warrant repair. No repair conducted.	Ductile fracture of the groove weld flange splice.	DS1 followed by complete failure of the web splice plate and dislocation of the two column segments on either side of the splice.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	0.95	0.05	1.00		
Fragility Parameters					
Median Demand, θ :	0.02	0.02	0.05		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	0.4	0.4	0.4		
Total Dispersion, β :	0.4	0.4	0.4		
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Superior		Rationality Superior	

Consequence Functions
Repair Description

Repair would involve gouging out the material adjacent to the fracture and repairing with a new groove weld. Field condition is deemed to not warrant repair by field observation. This Damage State is Mutually Exclusive with DS2. See fragility DS1 and DS2 probabilities.

Repair would involve gouging out the material adjacent to the fracture and repairing with a new groove weld.

Repair may not be practically feasible, but would require either realignment or replacement of adjacent column segments and rewelding of splice.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	0.00E+00	0.00E+00	0.00E+00	7.57E+03	1.13E+04	1.54E+04	9.57E+03	1.63E+04	1.85E+04						
Best fit mean:	0.00E+00			1.14E+04			1.48E+04								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	0.00E+00 0.00E+00			1.47E+04 9.07E+03			1.96E+04 1.39E+04								
CV or beta (Min Qty, Max Qty)	0.25 0.25			0.27 0.27			0.24 0.24								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	0.00E+00	0.00E+00	0.00E+00	5.01E+00	7.50E+00	1.02E+01	6.33E+00	1.08E+01	1.23E+01						
Best fit mean:	0.00E+00			7.57E+00			9.80E+00								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	0.00E+00 0.00E+00			9.76E+00 6.00E+00			1.30E+01 9.19E+00								
CV or beta (Min Qty, Max Qty)	0.35 0.35			0.37 0.37			0.34 0.34								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	0.0E+00	LogNormal	0.35	1.9E+02	Normal	0.37	4.8E+02	Normal	0.34						
Embodied Energy (MJ)	0.0E+00	LogNormal	0.35	5.9E+03	Normal	0.37	1.5E+04	Normal	0.34						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		2%	0.50							

Comments: from weld root area.

Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Greg Deierlein
Revisions: 2015-07-28 revise DS1 and DS2 description and repair to align with FEMA P-38 BD-3.8.3 Page 23. 2016-06-27 Revise DS1 to be MutEx zero cost version of itself.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification B1033.001a
NISTIR Name Special Concentric Braced Frame w WF braces, balanced design criteria, Chevron Brace, Brace w < 40 PLF
Description Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 8

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift RatioUnit less				
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 times brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.	

Illustrations					
	none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.001a-DS4-1.JPG	
Damage State Probability:	1.00	1.00	1.00	1.00	

Fragility Parameters					
Median Demand, θ :	0.0035	0.0058	0.0142	0.0283	
Data dispersion, β_d :	0.38	0.60	0.45	0.05	
Uncertainty, β_u :	0.25	0.25	0.25	0.25	
Total Dispersion, β :	0.45	0.65	0.5	0.25	
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Average	
Directionality (Yes / No)	YES	Data Relevance Superior		Rationality Superior	

Consequence Functions					
Repair Description	Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.	Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.	Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed	Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed	

Long Lead Time (Yes / No)	NO	NO	NO	NO	
Repair Costs:	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}
Repair Cost by Damage State:	1.51E+04 3.64E+04 4.10E+04	1.74E+04 3.94E+04 4.52E+04	1.88E+04 4.11E+04 4.76E+04	1.88E+04 4.11E+04 4.76E+04	
Best fit mean:	3.08E+04	3.40E+04	3.58E+04	3.58E+04	
Best Fit Distribution:	Normal	Normal	Normal	Normal	
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00	5.00 20.00	5.00 20.00	5.00 20.00	
Average Repair Cost (Min Qty, Max Qty)	4.73E+04 2.91E+04	4.72E+04 3.35E+04	4.93E+04 3.49E+04	4.93E+04 3.49E+04	
CV or beta (Min Qty, Max Qty)	0.33 0.33	0.32 0.32	0.31 0.31	0.31 0.31	
Quantity Unit:	Each	Each	Each	Each	
Repair Time:	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}
Repair Time by Damage State:	9.97E+00 2.41E+01 2.71E+01	1.15E+01 2.60E+01 2.99E+01	1.24E+01 2.72E+01 3.15E+01	1.24E+01 2.72E+01 3.15E+01	
Best fit mean:	2.04E+01	2.25E+01	2.37E+01	2.37E+01	
Best Fit Distribution:	Normal	Normal	Normal	Normal	
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00	5.00 20.00	5.00 20.00	5.00 20.00	
Average Repair Time (Min Qty, Max Qty)	3.13E+01 1.93E+01	3.13E+01 2.21E+01	3.26E+01 2.31E+01	3.26E+01 2.31E+01	
CV or beta (Min Qty, Max Qty)	0.41 0.41	0.41 0.41	0.40 0.40	0.40 0.40	
Quantity Unit:	Each	Each	Each	Each	
Environmental Impacts:	Median Cost Best Fit CV or Beta	Median Cost Best Fit CV or Beta	Median Cost Best Fit CV or Beta	Median Cost Best Fit CV or Beta	Median Cost Best Fit CV or Beta
Embodied Carbon (kg CO2eq)	7.0E+03 Normal 0.41	8.3E+03 Normal 0.41	8.3E+03 Normal 0.40	8.3E+03 Normal 0.40	
Embodied Energy (MJ)	8.7E+04 Normal 0.41	1.3E+05 Normal 0.41	1.3E+05 Normal 0.40	1.3E+05 Normal 0.40	
LifeSafety Hazard:					
Potential non-collapse casualties? (Yes / No)	NO	NO	NO	NO	
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable	Not Applicable	Not Applicable	Not Applicable	
Serious Injury (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00	0% 0.00	
Loss of Life (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00	0% 0.00	
Post-event Tagging Flag:	NO	YES	YES	YES	
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00	60% 0.50	40% 0.50	20% 0.50	

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.001b

NISTIR Name
Description

Special Concentric Braced Frame w WF braces, balanced design criteria, Chevron Brace, Brace 41 PLF < w < 99 PLF
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 9

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift RatioUnit less				
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 times brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.	

Illustrations

none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.001a-DS4-1.JPG	
1.00	1.00	1.00	1.00	

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.0035	0.0058	0.0142	0.0283	
Data dispersion, β_d :	0.38	0.60	0.45	0.05	
Uncertainty, β_u :	0.25	0.25	0.25	0.25	
Total Dispersion, β :	0.45	0.65	0.5	0.25	
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Average	
Directionality (Yes / No)	YES	Data Relevance Superior		Rationality Superior	

Consequence Functions

Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.51E+04	3.64E+04	4.10E+04	2.32E+04	4.65E+04	5.52E+04	2.60E+04	5.00E+04	6.01E+04	2.60E+04	5.00E+04	6.01E+04			
Best fit mean:	3.08E+04			4.16E+04			4.53E+04			4.53E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.73E+04 0.33			5.58E+04 0.30			6.00E+04 0.29			6.00E+04 0.29					
CV or beta (Min Qty, Max Qty)	Each			Each			Each			Each					
Quantity Unit:															
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.97E+00	2.41E+01	2.71E+01	1.53E+01	3.08E+01	3.65E+01	1.72E+01	3.31E+01	3.97E+01	1.72E+01	3.31E+01	3.97E+01			
Best fit mean:	2.04E+01			2.75E+01			3.00E+01			3.00E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	3.13E+01 0.41			3.69E+01 0.39			3.97E+01 0.39			3.97E+01 0.39					
CV or beta (Min Qty, Max Qty)	Each			Each			Each			Each					
Quantity Unit:															
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	7.0E+03	Normal	0.41	1.1E+04	Normal	0.39	1.1E+04	Normal	0.39	1.1E+04	Normal	0.39			
Embodied Energy (MJ)	8.7E+04	Normal	0.41	2.0E+05	Normal	0.39	2.0E+05	Normal	0.39	2.0E+05	Normal	0.39			
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			60% 0.50			40% 0.50			20% 0.50					

Comments: None

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Not Given

Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.001c

NISTIR Name
Description

Special Concentric Braced Frame w WF braces, balanced design criteria, Chevron Brace, Brace w > 100 PLF
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 10

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift RatioUnit less				
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 times brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.	

Illustrations

none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.001a-DS4-1.JPG	
1.00	1.00	1.00	1.00	

Damage State Probability:	1.00	1.00	1.00	1.00	
Fragility Parameters					
Median Demand, θ :	0.0035	0.0058	0.0142	0.0283	
Data dispersion, β_d :	0.38	0.60	0.45	0.05	
Uncertainty, β_u :	0.25	0.25	0.25	0.25	
Total Dispersion, β :	0.45	0.65	0.5	0.25	
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Average	
Directionality (Yes / No)	YES	Data Relevance Superior		Rationality Superior	

Consequence Functions

Repair Description	Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.	Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.	Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed	Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed	
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Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.51E+04	3.64E+04	4.10E+04	3.03E+04	5.54E+04	6.76E+04	3.47E+04	6.09E+04	7.53E+04	3.47E+04	6.09E+04	7.53E+04			
Best fit mean:	3.08E+04			5.11E+04			5.69E+04			5.69E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.73E+04			6.65E+04			7.31E+04			7.31E+04					
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.28 0.28			0.28 0.28			0.28 0.28					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.97E+00	2.41E+01	2.71E+01	2.00E+01	3.67E+01	4.47E+01	2.29E+01	4.03E+01	4.98E+01	2.29E+01	4.03E+01	4.98E+01			
Best fit mean:	2.04E+01			3.38E+01			3.77E+01			3.77E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	3.13E+01			4.40E+01			4.84E+01			4.84E+01					
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.38 0.38			0.37 0.37			0.37 0.37					
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	7.0E+03	Normal	0.41	1.4E+04	Normal	0.38	1.4E+04	Normal	0.37	1.4E+04	Normal	0.37			
Embodied Energy (MJ)	8.7E+04	Normal	0.41	2.9E+05	Normal	0.38	2.9E+05	Normal	0.37	2.9E+05	Normal	0.37			
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			60% 0.50			40% 0.50			20% 0.50					

Comments:	None				
Date Created:	Not Given				
Approved (YES / NO)?	By User				
Official (YES / NO) ?	By User				
Author:	Not Given				
Revisions:	2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.				
	Root Cost Multiplier: 1 Date Generated: 02/26/19				

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.002a

NISTIR Name

Special Concentric Braced Frame w WF braces, balanced design criteria, Single Diagonal Brace, Brace w < 40 PLF

Description

Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 11

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding Round Qty? YES

Allow sum by floor or building? NO

Demand Location (floor above?) No

Number of Damage States:

4

Damage State:

DS1

DS2

DS3

DS4

Type of Damage State:

Sequential

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3,DS4)

Descriptions

Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.

Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.

Buckling of brace in excess of 2 times brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.

Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.

Illustrations



Damage State Probability:

none

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.0035

0.0058

0.0142

0.0283

Data dispersion, β_d :

0.38

0.60

0.45

0.05

Uncertainty, β_u :

0.25

0.25

0.25

0.25

Total Dispersion, β :

0.45

0.65

0.5

0.25

Correlation (Yes / No)

NO

Data Quality Superior

Documentation Quality Average

Directionality (Yes / No)

YES

Data Relevance Superior

Rationality Superior

Consequence Functions

Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO

NO

NO

NO

Repair Costs:

	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.45E+04	3.56E+04	3.99E+04	1.71E+04	3.89E+04	4.46E+04	1.73E+04	3.92E+04	4.49E+04	1.73E+04	3.92E+04	4.49E+04	1.73E+04	3.92E+04	4.49E+04
Best fit mean:	3.00E+04			3.35E+04			3.38E+04			3.38E+04			3.38E+04		
Best Fit Distribution:	Normal			Normal			Normal			Normal			Normal		
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00		
Average Repair Cost (Min Qty, Max Qty)	4.63E+04 2.85E+04			4.67E+04 3.31E+04			4.70E+04 3.33E+04			4.70E+04 3.33E+04			4.70E+04 3.33E+04		
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.32 0.32			0.32 0.32			0.32 0.32			0.32 0.32		
Quantity Unit:	Each			Each			Each			Each			Each		

Repair Time:

	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.57E+00	2.36E+01	2.64E+01	1.13E+01	2.58E+01	2.95E+01	1.14E+01	2.59E+01	2.97E+01	1.14E+01	2.59E+01	2.97E+01	1.14E+01	2.59E+01	2.97E+01
Best fit mean:	1.98E+01			2.22E+01			2.23E+01			2.23E+01			2.23E+01		
Best Fit Distribution:	Normal			Normal			Normal			Normal			Normal		
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00		
Average Repair Time (Min Qty, Max Qty)	3.06E+01 1.89E+01			3.09E+01 2.19E+01			3.11E+01 2.20E+01			3.11E+01 2.20E+01			3.11E+01 2.20E+01		
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.41 0.41			0.41 0.41			0.41 0.41			0.41 0.41		
Quantity Unit:	Each			Each			Each			Each			Each		

Environmental Impacts:

	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	7.0E+03	Normal	0.41	7.8E+03	Normal	0.41	7.6E+03	Normal	0.41	7.6E+03	Normal	0.41	7.6E+03	Normal	0.41
Embodied Energy (MJ)	8.7E+04	Normal	0.41	1.1E+05	Normal	0.41	1.1E+05	Normal	0.41	1.1E+05	Normal	0.41	1.1E+05	Normal	0.41

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO			NO		
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable			Not Applicable		
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00			0% 0.00		
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00			0% 0.00		
Post-event Tagging Flag:	NO			YES			YES			YES			YES		
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			60% 0.50			40% 0.50			20% 0.50			20% 0.50		

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification
NISTIR Name
Description

B1033.002b
Special Concentric Braced Frame w WF braces, balanced design criteria, Single Diagonal Brace, 41 PLF < w < 99 PLF
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 12

Construction Quality:	Not Specified				
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1		Quantity Rounding Round Qty? YES		
Demand Parameter (unit):	Story Drift Ratio		Allow sum by floor or building? NO		
Number of Damage States:	4		Demand Location (floor above?) No		
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 times brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.	

Illustrations

none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.001a-DS4-1.JPG	
1.00	1.00	1.00	1.00	

Damage State Probability:	1.00	1.00	1.00	1.00	
Fragility Parameters					
Median Demand, θ :	0.0035	0.0058	0.0142	0.0283	
Data dispersion, β_d :	0.38	0.60	0.45	0.05	
Uncertainty, β_u :	0.25	0.25	0.25	0.25	
Total Dispersion, β :	0.45	0.65	0.5	0.25	
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Average	
Directionality (Yes / No)	YES	Data Relevance Superior		Rationality Superior	

Consequence Functions
Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.	Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.	Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed	Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed
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Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.45E+04	3.56E+04	3.99E+04	2.03E+04	4.29E+04	5.00E+04	2.27E+04	4.59E+04	5.42E+04	2.27E+04	4.59E+04	5.42E+04			
Best fit mean:	3.00E+04 Normal			3.77E+04 Normal			4.09E+04 Normal			4.09E+04 Normal					
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.63E+04 2.85E+04			5.14E+04 3.64E+04			5.50E+04 3.90E+04			5.50E+04 3.90E+04					
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.31 0.31			0.30 0.30			0.30 0.30					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.57E+00	2.36E+01	2.64E+01	1.34E+01	2.84E+01	3.31E+01	1.50E+01	3.04E+01	3.58E+01	1.50E+01	3.04E+01	3.58E+01			
Best fit mean:	1.98E+01 Normal			2.49E+01 Normal			2.71E+01 Normal			2.71E+01 Normal					
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	3.06E+01 1.89E+01			3.40E+01 2.41E+01			3.64E+01 2.58E+01			3.64E+01 2.58E+01					
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.40 0.40			0.39 0.39			0.39 0.39					
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	7.0E+03	Normal	0.41	9.3E+03	Normal	0.40	9.3E+03	Normal	0.39	9.3E+03	Normal	0.39			
Embodied Energy (MJ)	8.7E+04	Normal	0.41	1.6E+05	Normal	0.40	1.6E+05	Normal	0.39	1.6E+05	Normal	0.39			
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			60% 0.50			40% 0.50			20% 0.50					

Comments:
Date Created:
Approved (YES / NO)?
Official (YES / NO) ?
Author:
Revisions:

None
Not Given
By User
By User
Not Given
2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.002c

NISTIR Name
Description

Special Concentric Braced Frame w WF braces, balanced design criteria, Single Diagonal Brace, Brace w > 100 PLF
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 13

Construction Quality:	Not Specified				
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				Quantity Rounding Round Qty? YES
Demand Parameter (unit):	Story Drift Ratio Unit less				Allow sum by floor or building? NO
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 times brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.	

Illustrations

none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.001a-DS4-1.JPG	
1.00	1.00	1.00	1.00	

Damage State Probability:	1.00	1.00	1.00	1.00	
Fragility Parameters					
Median Demand, δ :	0.0035	0.0058	0.0142	0.0283	
Data dispersion, β_d :	0.38	0.60	0.45	0.05	
Uncertainty, β_u :	0.25	0.25	0.25	0.25	
Total Dispersion, β :	0.45	0.65	0.5	0.25	
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Average	
Directionality (Yes / No)	YES	Data Relevance Superior		Rationality Superior	

Consequence Functions
Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.45E+04	3.56E+04	3.99E+04	2.47E+04	4.84E+04	5.77E+04	2.91E+04	5.39E+04	6.54E+04	2.91E+04	5.39E+04	6.54E+04			
Best fit mean:	3.00E+04 Normal			4.36E+04 Normal			4.94E+04 Normal			4.94E+04 Normal					
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.63E+04 2.85E+04			5.80E+04 4.11E+04			6.46E+04 4.58E+04			6.46E+04 4.58E+04					
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.30 0.30			0.29 0.29			0.29 0.29					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.57E+00	2.36E+01	2.64E+01	1.63E+01	3.20E+01	3.82E+01	1.92E+01	3.57E+01	4.33E+01	1.92E+01	3.57E+01	4.33E+01			
Best fit mean:	1.98E+01 Normal			2.88E+01 Normal			3.27E+01 Normal			3.27E+01 Normal					
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	3.06E+01 1.89E+01			3.84E+01 2.72E+01			4.28E+01 3.03E+01			4.28E+01 3.03E+01					
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.39 0.39			0.38 0.38			0.38 0.38					
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	7.0E+03	Normal	0.41	1.1E+04	Normal	0.39	1.1E+04	Normal	0.38	1.1E+04	Normal	0.38			
Embodied Energy (MJ)	8.7E+04	Normal	0.41	2.2E+05	Normal	0.39	2.2E+05	Normal	0.38	2.2E+05	Normal	0.38			
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			60% 0.50			40% 0.50			20% 0.50					

Comments: None

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Not Given

Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification B1033.003a
NISTIR Name Special Concentric Braced Frame w WF braces, balanced design criteria, X Brace, Brace w < 40 PLF
Description Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 14

Construction Quality:	Not Specified				Quantity Rounding Round Qty? YES Allow sum by floor or building? NO Demand Location (floor above)? No
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio Unit less				
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)				
Descriptions	<p>Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.</p> <p>Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.</p> <p>Buckling of brace in excess of 2 times brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.</p> <p>Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.</p>				

Illustrations					
	none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.001a-DS4-1.JPG	
Damage State Probability:	1.00	1.00	1.00	1.00	

Fragility Parameters					
Median Demand, θ :	0.0035	0.0058	0.0142	0.0283	
Data dispersion, β_d :	0.38	0.60	0.45	0.05	
Uncertainty, β_u :	0.25	0.25	0.25	0.25	
Total Dispersion, β :	0.45	0.65	0.5	0.25	
Correlation (Yes / No)	NO		Data Quality Superior		Documentation Quality Average
Directionality (Yes / No)	YES		Data Relevance Superior		Rationality Superior

Consequence Functions					
Repair Description	<p>Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.</p> <p>Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.</p> <p>Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed</p> <p>Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed</p>				

Long Lead Time (Yes / No)	NO			NO			NO			NO		
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.58E+04	3.72E+04	4.22E+04	2.02E+04	4.28E+04	5.00E+04	2.10E+04	4.38E+04	5.14E+04	2.10E+04	4.38E+04	5.14E+04
Best fit mean:	3.17E+04			3.76E+04			3.87E+04			3.87E+04		
Best Fit Distribution:	Normal			Normal			Normal			Normal		
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00		
Average Repair Cost (Min Qty, Max Qty)	4.84E+04 2.98E+04			5.14E+04 3.64E+04			5.26E+04 3.72E+04			5.26E+04 3.72E+04		
CV or beta (Min Qty, Max Qty)	0.32 0.32			0.31 0.31			0.31 0.31			0.31 0.31		
Quantity Unit:	Each			Each			Each			Each		
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.04E+01	2.46E+01	2.79E+01	1.33E+01	2.83E+01	3.31E+01	1.39E+01	2.90E+01	3.40E+01	1.39E+01	2.90E+01	3.40E+01
Best fit mean:	2.10E+01			2.49E+01			2.56E+01			2.56E+01		
Best Fit Distribution:	Normal			Normal			Normal			Normal		
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00		
Average Repair Time (Min Qty, Max Qty)	3.20E+01 1.97E+01			3.40E+01 2.41E+01			3.48E+01 2.47E+01			3.48E+01 2.47E+01		
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.40 0.40			0.40 0.40			0.40 0.40		
Quantity Unit:	Each			Each			Each			Each		
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	7.0E+03	Normal	0.41	9.3E+03	Normal	0.40	9.3E+03	Normal	0.40	9.3E+03	Normal	0.40
Embodied Energy (MJ)	8.7E+04	Normal	0.41	1.5E+05	Normal	0.40	1.5E+05	Normal	0.40	1.5E+05	Normal	0.40
LifeSafety Hazard:	NO			NO			NO			NO		
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO		
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable		
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00		
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00		
Post-event Tagging Flag:	NO			YES			YES			YES		
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			60% 0.50			40% 0.50			20% 0.50		

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification B1033.003b
NISTIR Name Special Concentric Braced Frame w WF braces, balanced design criteria, X Brace, 41 PLF < w < 99 PLF
Description Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 15

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift RatioUnit less				
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 times brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.	

Illustrations					
	none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.001a-DS4-1.JPG	
Damage State Probability:	1.00	1.00	1.00	1.00	

Fragility Parameters					
Median Demand, θ :	0.0035	0.0058	0.0142	0.0283	
Data dispersion, β_d :	0.38	0.60	0.45	0.05	
Uncertainty, β_u :	0.25	0.25	0.25	0.25	
Total Dispersion, β :	0.45	0.65	0.5	0.25	
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Average	
Directionality (Yes / No)	YES	Data Relevance Superior		Rationality Superior	

Consequence Functions					
Repair Description	Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.	Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.	Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed	Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed	

Long Lead Time (Yes / No)	NO	NO	NO	NO	
Repair Costs:	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}
Repair Cost by Damage State:	1.58E+043.72E+044.22E+04	2.84E+045.30E+046.42E+04	3.08E+045.60E+046.84E+04	3.08E+045.60E+046.84E+04	
Best fit mean:	3.17E+04	4.85E+04	5.17E+04	5.17E+04	
Best Fit Distribution:	Normal	Normal	Normal	Normal	
Quantity Plateau (Min Qty, Max Qty)	5.0020.00	5.0020.00	5.0020.00	5.0020.00	
Average Repair Cost (Min Qty, Max Qty)	4.84E+042.98E+04	6.36E+044.50E+04	6.72E+044.76E+04	6.72E+044.76E+04	
CV or beta (Min Qty, Max Qty)	0.320.32	0.290.29	0.280.28	0.280.28	
Quantity Unit:	Each	Each	Each	Each	
Repair Time:	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}
Repair Time by Damage State:	1.04E+012.46E+012.79E+01	1.88E+013.51E+014.25E+01	2.04E+013.70E+014.52E+01	2.04E+013.70E+014.52E+01	
Best fit mean:	2.10E+01	3.21E+01	3.42E+01	3.42E+01	
Best Fit Distribution:	Normal	Normal	Normal	Normal	
Quantity Plateau (Min Qty, Max Qty)	5.0020.00	5.0020.00	5.0020.00	5.0020.00	
Average Repair Time (Min Qty, Max Qty)	3.20E+011.97E+01	4.21E+012.98E+01	4.45E+013.15E+01	4.45E+013.15E+01	
CV or beta (Min Qty, Max Qty)	0.410.41	0.380.38	0.380.38	0.380.38	
Quantity Unit:	Each	Each	Each	Each	
Environmental Impacts:	Median CostBest FitCV or Beta	Median CostBest FitCV or Beta	Median CostBest FitCV or Beta	Median CostBest FitCV or Beta	Median CostBest FitCV or Beta
Embodied Carbon (kg CO2eq)	7.0E+03Normal0.41	1.3E+04Normal0.38	1.3E+04Normal0.38	1.3E+04Normal0.38	
Embodied Energy (MJ)	8.7E+04Normal0.41	2.6E+05Normal0.38	2.6E+05Normal0.38	2.6E+05Normal0.38	
LifeSafety Hazard:					
Potential non-collapse casualties? (Yes / No)	NO	NO	NO	NO	
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable	Not Applicable	Not Applicable	Not Applicable	
Serious Injury (Median, Dispersion)	0%0.00	0%0.00	0%0.00	0%0.00	
Loss of Life (Median, Dispersion)	0%0.00	0%0.00	0%0.00	0%0.00	
Post-event Tagging Flag:	NO	YES	YES	YES	
Unsafe Placard Trigger (Median, Dispersion)	0%0.00	60%0.50	40%0.50	20%0.50	

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification B1033.003c
NISTIR Name Special Concentric Braced Frame w WF braces, balanced design criteria, X Brace, Brace w > 100 PLF
Description Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 16

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift RatioUnit less				
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 times brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.	

Illustrations					
	none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.001a-DS4-1.JPG	
Damage State Probability:	1.00	1.00	1.00	1.00	

Fragility Parameters					
Median Demand, θ :	0.0035	0.0058	0.0142	0.0283	
Data dispersion, β_d :	0.38	0.60	0.45	0.05	
Uncertainty, β_u :	0.25	0.25	0.25	0.25	
Total Dispersion, β :	0.45	0.65	0.5	0.25	
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Average	
Directionality (Yes / No)	YES	Data Relevance Superior		Rationality Superior	

Consequence Functions					
Repair Description	Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.	Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.	Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed	Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed	

Long Lead Time (Yes / No)	NO	NO	NO	NO	
Repair Costs:	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}
Repair Cost by Damage State:	1.58E+043.72E+044.22E+04	3.84E+046.55E+048.17E+04	4.28E+047.10E+048.94E+04	4.28E+047.10E+048.94E+04	
Best fit mean:	3.17E+04	6.18E+04	6.77E+04	6.77E+04	
Best Fit Distribution:	Normal	Normal	Normal	Normal	
Quantity Plateau (Min Qty, Max Qty)	5.0020.00	5.0020.00	5.0020.00	5.0020.00	
Average Repair Cost (Min Qty, Max Qty)	4.84E+042.98E+04	7.86E+045.57E+04	8.52E+046.03E+04	8.52E+046.03E+04	
CV or beta (Min Qty, Max Qty)	0.320.32	0.270.27	0.270.27	0.270.27	
Quantity Unit:	Each	Each	Each	Each	
Repair Time:	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}
Repair Time by Damage State:	1.04E+012.46E+012.79E+01	2.54E+014.33E+015.40E+01	2.83E+014.70E+015.91E+01	2.83E+014.70E+015.91E+01	
Best fit mean:	2.10E+01	4.09E+01	4.48E+01	4.48E+01	
Best Fit Distribution:	Normal	Normal	Normal	Normal	
Quantity Plateau (Min Qty, Max Qty)	5.0020.00	5.0020.00	5.0020.00	5.0020.00	
Average Repair Time (Min Qty, Max Qty)	3.20E+011.97E+01	5.20E+013.68E+01	5.64E+013.99E+01	5.64E+013.99E+01	
CV or beta (Min Qty, Max Qty)	0.410.41	0.370.37	0.370.37	0.370.37	
Quantity Unit:	Each	Each	Each	Each	
Environmental Impacts:	Median CostBest FitCV or Beta	Median CostBest FitCV or Beta	Median CostBest FitCV or Beta	Median CostBest FitCV or Beta	Median CostBest FitCV or Beta
Embodied Carbon (kg CO2eq)	7.0E+03Normal0.41	1.8E+04Normal0.37	1.8E+04Normal0.37	1.8E+04Normal0.37	
Embodied Energy (MJ)	8.7E+04Normal0.41	4.0E+05Normal0.37	4.0E+05Normal0.37	4.0E+05Normal0.37	
LifeSafety Hazard:					
Potential non-collapse casualties? (Yes / No)	NO	NO	NO	NO	
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable	Not Applicable	Not Applicable	Not Applicable	
Serious Injury (Median, Dispersion)	0%0.00	0%0.00	0%0.00	0%0.00	
Loss of Life (Median, Dispersion)	0%0.00	0%0.00	0%0.00	0%0.00	
Post-event Tagging Flag:	NO	YES	YES	YES	
Unsafe Placard Trigger (Median, Dispersion)	0%0.00	60%0.50	40%0.50	20%0.50	

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification
NISTIR Name
Description

B1033.011a
Special Concentric Braced Frame w HSS braces, balanced design criteria, Chevron Brace, Brace w < 40 PLF
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 17

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift RatioUnit less				
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 times brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.	

Illustrations

				
none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.011a-DS3-2.JPG	
1.00	1.00	1.00	1.00	

Damage State Probability:	1.00	1.00	1.00	1.00	
Fragility Parameters					
Median Demand, θ :	0.0035	0.0092	0.0167	0.0223	
Data dispersion, β_d :	0.38	0.30	0.1	0.1	
Uncertainty, β_u :	0.25	0.1	0.1	0.1	
Total Dispersion, β :	0.45	0.3	0.15	0.15	
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Superior		Rationality Superior	

Consequence Functions
Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.45E+04	3.56E+04	3.99E+04	1.80E+04	4.00E+04	4.60E+04	1.94E+04	4.17E+04	4.84E+04	1.94E+04	4.17E+04	4.84E+04			
Best fit mean:	3.00E+04			3.46E+04			3.65E+04			3.65E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.63E+04 2.85E+04			4.80E+04 3.40E+04			5.01E+04 3.55E+04			5.01E+04 3.55E+04					
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.32 0.32			0.31 0.31			0.31 0.31					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.57E+00	2.36E+01	2.64E+01	1.19E+01	2.65E+01	3.04E+01	1.28E+01	2.76E+01	3.20E+01	1.28E+01	2.76E+01	3.20E+01			
Best fit mean:	1.98E+01			2.29E+01			2.41E+01			2.41E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	3.07E+01 1.89E+01			3.18E+01 2.25E+01			3.31E+01 2.35E+01			3.31E+01 2.35E+01					
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.40 0.40			0.40 0.40			0.40 0.40					
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.7E+03	Normal	0.41	8.5E+03	Normal	0.40	8.5E+03	Normal	0.40	8.5E+03	Normal	0.40			
Embodied Energy (MJ)	8.0E+04	Normal	0.41	1.3E+05	Normal	0.40	1.3E+05	Normal	0.40	1.3E+05	Normal	0.40			
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	60% 0.50			40% 0.50			20% 0.50			20% 0.50					

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification
NISTIR Name
Description

B1033.011b
Special Concentric Braced Frame w HSS braces, balanced design criteria, Chevron Brace, Brace 41 PLF < w < 99 PLF
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 18

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift RatioUnit less				
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 times brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.	

Illustrations

none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.011a-DS3-2.JPG	
1.00	1.00	1.00	1.00	

Damage State Probability:	1.00	1.00	1.00	1.00	
Fragility Parameters					
Median Demand, θ :	0.0035	0.0092	0.0167	0.0223	
Data dispersion, β_d :	0.38	0.30	0.1	0.1	
Uncertainty, β_u :	0.25	0.1	0.1	0.1	
Total Dispersion, β :	0.45	0.3	0.15	0.15	
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Superior		Rationality Superior	

Consequence Functions
Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.45E+04	3.56E+04	3.99E+04	2.51E+04	4.89E+04	5.85E+04	2.79E+04	5.24E+04	6.34E+04	2.79E+04	5.24E+04	6.34E+04	2.79E+04	5.24E+04	6.34E+04
Best fit mean:	3.00E+04			4.41E+04			4.79E+04			4.79E+04			4.79E+04		
Best Fit Distribution:	Normal			Normal			Normal			Normal			Normal		
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00		
Average Repair Cost (Min Qty, Max Qty)	4.63E+04			5.87E+04			6.29E+04			6.29E+04			6.29E+04		
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.30 0.30			0.29 0.29			0.29 0.29			0.29 0.29		
Quantity Unit:	Each			Each			Each			Each			Each		
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.57E+00	2.36E+01	2.64E+01	1.66E+01	3.24E+01	3.87E+01	1.84E+01	3.47E+01	4.19E+01	1.84E+01	3.47E+01	4.19E+01	1.84E+01	3.47E+01	4.19E+01
Best fit mean:	1.98E+01			2.92E+01			3.17E+01			3.17E+01			3.17E+01		
Best Fit Distribution:	Normal			Normal			Normal			Normal			Normal		
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00		
Average Repair Time (Min Qty, Max Qty)	3.07E+01			3.89E+01			4.16E+01			4.16E+01			4.16E+01		
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.39 0.39			0.38 0.38			0.38 0.38			0.38 0.38		
Quantity Unit:	Each			Each			Each			Each			Each		
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.7E+03	Normal	0.41	1.2E+04	Normal	0.39	1.2E+04	Normal	0.38	1.2E+04	Normal	0.38	1.2E+04	Normal	0.38
Embodied Energy (MJ)	8.0E+04	Normal	0.41	2.3E+05	Normal	0.39	2.3E+05	Normal	0.38	2.3E+05	Normal	0.38	2.3E+05	Normal	0.38
LifeSafety Hazard:	NO			NO			NO			NO			NO		
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO			NO		
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable			Not Applicable		
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00			0% 0.00		
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00			0% 0.00		
Post-event Tagging Flag:	NO			YES			YES			YES			YES		
Unsafe Placard Trigger (Median, Dispersion)	60% 0.50			40% 0.50			20% 0.50			20% 0.50			20% 0.50		

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification
NISTIR Name
Description

B1033.011c
Special Concentric Braced Frame w HSS braces, balanced design criteria, Chevron Brace, Brace w > 100 PLF
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 19

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift RatioUnit less				
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 times brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.	

Illustrations

				
none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.011a-DS3-2.JPG	
1.00	1.00	1.00	1.00	

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.0035	0.0092	0.0167	0.0223	
Data dispersion, β_d :	0.38	0.30	0.1	0.1	
Uncertainty, β_u :	0.25	0.1	0.1	0.1	
Total Dispersion, β :	0.45	0.3	0.15	0.15	
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Superior		Rationality Superior	

Consequence Functions
Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.45E+04	3.56E+04	3.99E+04	3.40E+04	6.01E+04	7.41E+04	3.80E+04	6.51E+04	8.11E+04	3.80E+04	6.51E+04	8.11E+04			
Best fit mean:	3.00E+04			5.60E+04			6.14E+04			6.14E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.28E+04 0.33 0.33			7.21E+04 0.28 0.28			7.81E+04 0.27 0.27			7.81E+04 0.27 0.27					
CV or beta (Min Qty, Max Qty)	Each			Each			Each			Each					
Quantity Unit:															
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.57E+00	2.36E+01	2.64E+01	2.25E+01	3.98E+01	4.90E+01	2.51E+01	4.31E+01	5.36E+01	2.51E+01	4.31E+01	5.36E+01			
Best fit mean:	1.98E+01			3.71E+01			4.06E+01			4.06E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.83E+01 0.41 0.41			4.77E+01 0.37 0.37			5.17E+01 0.37 0.37			5.17E+01 0.37 0.37					
CV or beta (Min Qty, Max Qty)	Each			Each			Each			Each					
Quantity Unit:															
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.7E+03	Normal	0.41	1.6E+04	Normal	0.37	1.6E+04	Normal	0.37	1.6E+04	Normal	0.37			
Embodied Energy (MJ)	8.0E+04	Normal	0.41	3.4E+05	Normal	0.37	3.4E+05	Normal	0.37	3.4E+05	Normal	0.37			
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Casualty-affected Planar Area (sf) per Normative Unit:	0% 0.00 0%			0% 0.00 0%			0% 0.00 0%			0% 0.00 0%					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	60% 0.50			40% 0.50			20% 0.50			20% 0.50					

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.012a

NISTIR Name

Special Concentric Braced Frame w HSS braces, balanced design criteria, Single Diagonal Brace, Brace w < 40 PLF

Description

Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 20

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding

Round Qty? YES

Allow sum by floor or building? NO

Demand Location (floor above?) No

Number of Damage States:

4

Damage State:

DS1

DS2

DS3

DS4

Type of Damage State:

Sequential

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3,DS4)

Descriptions

Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.

Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.

Buckling of brace in excess of 2 times brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.

Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.

Illustrations



Damage State Probability:

none

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.0035

0.0092

0.0167

0.0223

Data dispersion, β_d :

0.38

0.30

0.1

0.1

Uncertainty, β_u :

0.25

0.1

0.1

0.1

Total Dispersion, β :

0.45

0.3

0.15

0.15

Correlation (Yes / No)

NO

Data Quality Superior

Documentation Quality Superior

Directionality (Yes / No)

YES

Data Relevance Superior

Rationality Superior

Consequence Functions

Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.39E+04	3.49E+04	3.88E+04	1.69E+04	3.86E+04	4.41E+04	1.77E+04	3.96E+04	4.55E+04	1.77E+04	3.96E+04	4.55E+04			
Best fit mean:	2.92E+04 Normal			3.32E+04 Normal			3.43E+04 Normal			3.43E+04 Normal					
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.18E+04 2.79E+04			4.64E+04 3.09E+04			4.76E+04 3.17E+04			4.76E+04 3.17E+04					
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.32 0.32			0.32 0.32			0.32 0.32					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.17E+00	2.31E+01	2.57E+01	1.12E+01	2.56E+01	2.92E+01	1.17E+01	2.62E+01	3.01E+01	1.17E+01	2.62E+01	3.01E+01			
Best fit mean:	1.93E+01 Normal			2.20E+01 Normal			2.27E+01 Normal			2.27E+01 Normal					
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.77E+01 1.85E+01			3.07E+01 2.05E+01			3.15E+01 2.10E+01			3.15E+01 2.10E+01					
CV or beta (Min Qty, Max Qty)	0.42 0.42			0.41 0.41			0.40 0.40			0.40 0.40					
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	6.7E+03	Normal	0.42	7.9E+03	Normal	0.41	7.7E+03	Normal	0.40	7.7E+03	Normal	0.40			
Embodied Energy (MJ)	8.0E+04	Normal	0.42	1.2E+05	Normal	0.41	1.1E+05	Normal	0.40	1.1E+05	Normal	0.40			
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	60% 0.50			40% 0.50			20% 0.50			20% 0.50					

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification
NISTIR Name
Description

B1033.012b
Special Concentric Braced Frame w HSS braces, balanced design criteria, Single Diagonal Brace, Brace 41 PLF < w < 99 PLF
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 21

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift RatioUnit less				
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)				
Descriptions	<div>Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.</div> <div>Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.</div> <div>Buckling of brace in excess of 2 times brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.</div> <div>Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.</div>				

Illustrations

				
none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.011a-DS3-2.JPG	
1.00	1.00	1.00	1.00	

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.0035	0.0092	0.0167	0.0223	
Data dispersion, β_d :	0.38	0.30	0.1	0.1	
Uncertainty, β_u :	0.25	0.1	0.1	0.1	
Total Dispersion, β :	0.45	0.3	0.15	0.15	
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Superior		Rationality Superior	

Consequence Functions
Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.	Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.	Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed	Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed
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Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.39E+04	3.49E+04	3.88E+04	2.12E+04	4.40E+04	5.17E+04	2.40E+04	4.75E+04	5.66E+04	2.40E+04	4.75E+04	5.66E+04			
Best fit mean:	2.92E+04 Normal			3.89E+04 Normal			4.27E+04 Normal			4.27E+04 Normal					
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.18E+04 2.79E+04			5.28E+04 3.52E+04			5.70E+04 3.80E+04			5.70E+04 3.80E+04					
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.31 0.31			0.30 0.30			0.30 0.30					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.17E+00	2.31E+01	2.57E+01	1.40E+01	2.91E+01	3.42E+01	1.59E+01	3.14E+01	3.74E+01	1.59E+01	3.14E+01	3.74E+01			
Best fit mean:	1.93E+01 Normal			2.58E+01 Normal			2.82E+01 Normal			2.82E+01 Normal					
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.77E+01 1.85E+01			3.50E+01 2.33E+01			3.77E+01 2.52E+01			3.77E+01 2.52E+01					
CV or beta (Min Qty, Max Qty)	0.42 0.42			0.39 0.39			0.39 0.39			0.39 0.39					
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.7E+03	Normal	0.42	9.9E+03	Normal	0.39	9.9E+03	Normal	0.39	9.9E+03	Normal	0.39			
Embodied Energy (MJ)	8.0E+04	Normal	0.42	1.7E+05	Normal	0.39	1.7E+05	Normal	0.39	1.7E+05	Normal	0.39			
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	60% 0.50			40% 0.50			20% 0.50			20% 0.50					

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.012c

NISTIR Name

Special Concentric Braced Frame w HSS braces, balanced design criteria, Single Diagonal Brace, Brace w > 100 PLF
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding

Round Qty? YES

Allow sum by floor or building? NO

Demand Location (floor above?) No

Number of Damage States:

4

Damage State:

DS1

DS2

DS3

DS4

Type of Damage State:

Sequential

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3,DS4)

Descriptions

Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.

Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.

Buckling of brace in excess of 2 times brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.

Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.

Illustrations



Damage State Probability:

none

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.0035

0.0092

0.0167

0.0223

Data dispersion, β_d :

0.38

0.30

0.1

0.1

Uncertainty, β_u :

0.25

0.1

0.1

0.1

Total Dispersion, β :

0.45

0.3

0.15

0.15

Correlation (Yes / No)

NO

Directionality (Yes / No)

YES

Data Quality Superior

Data Relevance Superior

Documentation Quality Superior

Rationality Superior

Consequence Functions

Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.39E+04	3.49E+04	3.88E+04	2.70E+04	5.12E+04	6.17E+04	3.14E+04	5.67E+04	6.94E+04	3.14E+04	5.67E+04	6.94E+04			
Best fit mean:	2.92E+04 Normal			4.66E+04 Normal			5.25E+04 Normal			5.25E+04 Normal					
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.18E+04 2.79E+04			6.15E+04 4.10E+04			6.81E+04 4.54E+04			6.81E+04 4.54E+04					
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.29 0.29			0.28 0.28			0.28 0.28					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.17E+00	2.31E+01	2.57E+01	1.78E+01	3.39E+01	4.08E+01	2.08E+01	3.75E+01	4.59E+01	2.08E+01	3.75E+01	4.59E+01			
Best fit mean:	1.93E+01 Normal			3.08E+01 Normal			3.47E+01 Normal			3.47E+01 Normal					
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.77E+01 1.85E+01			4.07E+01 2.71E+01			4.50E+01 3.00E+01			4.50E+01 3.00E+01					
CV or beta (Min Qty, Max Qty)	0.42 0.42			0.38 0.38			0.38 0.38			0.38 0.38					
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	6.7E+03	Normal	0.42	1.3E+04	Normal	0.38	1.3E+04	Normal	0.38	1.3E+04	Normal	0.38			
Embodied Energy (MJ)	8.0E+04	Normal	0.42	2.5E+05	Normal	0.38	2.5E+05	Normal	0.38	2.5E+05	Normal	0.38			
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	60% 0.50			40% 0.50			20% 0.50			20% 0.50					

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1




Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification B1033.013a
NISTIR Name Special Concentric Braced Frame w HSS braces, balanced design criteria, X Brace, Brace w < 40 PLF
Description Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 23

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift RatioUnit less				
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 times brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.	

Illustrations					
					
	none 1.00	B1033.001a-DS2-1.JPG 1.00	B1033.001a-DS3-1.JPG 1.00	B1033.011a-DS3-2.JPG 1.00	
Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.0035	0.0092	0.0167	0.0223	
Data dispersion, β_d :	0.38	0.30	0.1	0.1	
Uncertainty, β_u :	0.25	0.1	0.1	0.1	
Total Dispersion, β :	0.45	0.3	0.15	0.15	
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Superior		Rationality Superior	

Consequence Functions					
Repair Description	Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.	Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.	Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed	Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed	

Long Lead Time (Yes / No)	NO	NO	NO	NO	
Repair Costs:	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}
Repair Cost by Damage State:	1.52E+043.65E+044.11E+04	2.04E+044.30E+045.02E+04	2.16E+044.45E+045.23E+04	2.16E+044.45E+045.23E+04	
Best fit mean:	3.09E+04	3.78E+04	3.94E+04	3.94E+04	
Best Fit Distribution:	Normal	Normal	Normal	Normal	
Quantity Plateau (Min Qty, Max Qty)	5.0020.00	5.0020.00	5.0020.00	5.0020.00	
Average Repair Cost (Min Qty, Max Qty)	4.38E+042.92E+04	5.16E+043.44E+04	5.34E+043.56E+04	5.34E+043.56E+04	
CV or beta (Min Qty, Max Qty)	0.330.33	0.310.31	0.300.30	0.300.30	
Quantity Unit:	Each	Each	Each	Each	
Repair Time:	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}
Repair Time by Damage State:	1.00E+012.41E+012.72E+01	1.35E+012.85E+013.32E+01	1.43E+012.94E+013.46E+01	1.43E+012.94E+013.46E+01	
Best fit mean:	2.04E+01	2.50E+01	2.61E+01	2.61E+01	
Best Fit Distribution:	Normal	Normal	Normal	Normal	
Quantity Plateau (Min Qty, Max Qty)	5.0020.00	5.0020.00	5.0020.00	5.0020.00	
Average Repair Time (Min Qty, Max Qty)	2.90E+011.93E+01	3.41E+012.28E+01	3.53E+012.36E+01	3.53E+012.36E+01	
CV or beta (Min Qty, Max Qty)	0.410.41	0.400.40	0.390.39	0.390.39	
Quantity Unit:	Each	Each	Each	Each	
Environmental Impacts:	Median CostBest FitCV or Beta	Median CostBest FitCV or Beta	Median CostBest FitCV or Beta	Median CostBest FitCV or Beta	Median CostBest FitCV or Beta
Embodied Carbon (kg CO2eq)	6.7E+03Normal0.41	9.5E+03Normal0.40	9.5E+03Normal0.39	9.5E+03Normal0.39	
Embodied Energy (MJ)	8.0E+04Normal0.41	1.6E+05Normal0.40	1.6E+05Normal0.39	1.6E+05Normal0.39	
LifeSafety Hazard:					
Potential non-collapse casualties? (Yes / No)	NO	NO	NO	NO	
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable	Not Applicable	Not Applicable	Not Applicable	
Serious Injury (Median, Dispersion)	0%0.00	0%0.00	0%0.00	0%0.00	
Loss of Life (Median, Dispersion)	0%0.00	0%0.00	0%0.00	0%0.00	
Post-event Tagging Flag:	NO	YES	YES	YES	
Unsafe Placard Trigger (Median, Dispersion)	60%0.50	40%0.50	20%0.50	20%0.50	

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification B1033.013b
NISTIR Name Special Concentric Braced Frame w HSS braces, balanced design criteria, X Brace, Brace 41 PLF < w < 99 PLF
Description Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 24

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift RatioUnit less				
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 times brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.	

Illustrations					
	none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.011a-DS3-2.JPG	
Damage State Probability:	1.00	1.00	1.00	1.00	

Fragility Parameters					
Median Demand, θ :	0.0035	0.0092	0.0167	0.0223	
Data dispersion, β_d :	0.38	0.30	0.1	0.1	
Uncertainty, β_u :	0.25	0.1	0.1	0.1	
Total Dispersion, β :	0.45	0.3	0.15	0.15	
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Superior		Rationality Superior	

Consequence Functions					
Repair Description	Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.	Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.	Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed	Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed	

Long Lead Time (Yes / No) NO NO NO NO

Repair Costs:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Cost by Damage State:	1.52E+04	3.65E+04	4.11E+04	3.04E+04	5.55E+04	6.77E+04	3.32E+04	5.90E+04	7.26E+04	3.32E+04	5.90E+04	7.26E+04			
Best fit mean:	3.09E+04			5.12E+04			5.49E+04			5.49E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.38E+04 2.92E+04			6.65E+04 4.44E+04			7.07E+04 4.72E+04			7.07E+04 4.72E+04					
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.28 0.28			0.28 0.28			0.28 0.28					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Time by Damage State:	1.00E+01	2.41E+01	2.72E+01	2.01E+01	3.67E+01	4.48E+01	2.19E+01	3.90E+01	4.80E+01	2.19E+01	3.90E+01	4.80E+01			
Best fit mean:	2.04E+01			3.39E+01			3.63E+01			3.63E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.90E+01 1.93E+01			4.40E+01 2.94E+01			4.68E+01 3.12E+01			4.68E+01 3.12E+01					
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.38 0.38			0.38 0.38			0.38 0.38					
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.7E+03	Normal	0.41	1.4E+04	Normal	0.38	1.4E+04	Normal	0.38	1.4E+04	Normal	0.38			
Embodied Energy (MJ)	8.0E+04	Normal	0.41	2.9E+05	Normal	0.38	2.9E+05	Normal	0.38	2.9E+05	Normal	0.38			
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	60% 0.50			40% 0.50			20% 0.50			20% 0.50					

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification B1033.013c
NISTIR Name Special Concentric Braced Frame w HSS braces, balanced design criteria, X Brace, Brace w > 100 PLF
Description Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 25

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift RatioUnit less				
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 times brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.	

Illustrations

none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.011a-DS3-2.JPG	
1.00	1.00	1.00	1.00	

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.0035	0.0092	0.0167	0.0223	
Data dispersion, β_d :	0.38	0.30	0.1	0.1	
Uncertainty, β_u :	0.25	0.1	0.1	0.1	
Total Dispersion, β :	0.45	0.3	0.15	0.15	
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Superior		Rationality Superior	

Consequence Functions
Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.	Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.	Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed	Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed	
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Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.52E+04	3.65E+04	4.11E+04	4.25E+04	7.07E+04	8.90E+04	4.69E+04	7.62E+04	9.67E+04	4.69E+04	7.62E+04	9.67E+04			
Best fit mean:	3.09E+04			6.74E+04			7.32E+04			7.32E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.38E+04 2.92E+04			8.48E+04 5.65E+04			9.14E+04 6.09E+04			9.14E+04 6.09E+04					
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.27 0.27			0.27 0.27			0.27 0.27					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.00E+01	2.41E+01	2.72E+01	2.81E+01	4.68E+01	5.89E+01	3.10E+01	5.04E+01	6.40E+01	3.10E+01	5.04E+01	6.40E+01			
Best fit mean:	2.04E+01			4.46E+01			4.85E+01			4.85E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.90E+01 1.93E+01			5.61E+01 3.74E+01			6.05E+01 4.03E+01			6.05E+01 4.03E+01					
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.37 0.37			0.36 0.36			0.36 0.36					
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.7E+03	Normal	0.41	2.0E+04	Normal	0.37	2.0E+04	Normal	0.36	2.0E+04	Normal	0.36			
Embodied Energy (MJ)	8.0E+04	Normal	0.41	4.6E+05	Normal	0.37	4.6E+05	Normal	0.36	4.6E+05	Normal	0.36			
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	60% 0.50			40% 0.50			20% 0.50			20% 0.50					

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification
NISTIR Name
Description

B1033.021a
Special Concentric Braced Frame w HSS braces, tapered gusset plates & design to AISC minimum standard, Chevron Brace, Brace w < 40 PLF
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 26

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift RatioUnit less				
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.		Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.		Buckling of brace in excess of 2 time brace depth . Yielding and out-of-plane deformation of gusset . Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture . Significant yielding and local buckling in beams and columns adjacent to gusset .
					Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.

Illustrations

				
none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.011a-DS3-2.JPG	
1.00	1.00	1.00	1.00	

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.0037	0.0075	0.0145	0.0199	
Data dispersion, β_d :	0.26	0.25	0.2	0.35	
Uncertainty, β_u :	0.1	0.1	0.1	0.1	
Total Dispersion, β :	0.3	0.25	0.25	0.35	
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Average	
Directionality (Yes / No)	YES	Data Relevance Superior		Rationality Superior	

Consequence Functions
Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness or straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. Tapered gusset plates typically sustain greater damage and there is a higher probability that replacement will be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.49E+04	3.61E+04	4.05E+04	1.84E+04	4.05E+04	4.66E+04	1.98E+04	4.22E+04	4.90E+04	1.98E+04	4.22E+04	4.90E+04			
Best fit mean:	3.05E+04			3.51E+04			3.70E+04			3.70E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.33E+04 2.89E+04			4.86E+04 3.24E+04			5.06E+04 3.37E+04			5.06E+04 3.37E+04					
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.31 0.31			0.31 0.31			0.31 0.31					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.83E+00	2.39E+01	2.68E+01	1.22E+01	2.68E+01	3.08E+01	1.31E+01	2.79E+01	3.24E+01	1.31E+01	2.79E+01	3.24E+01			
Best fit mean:	2.02E+01			2.32E+01			2.45E+01			2.45E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.87E+01 1.91E+01			3.21E+01 2.14E+01			3.35E+01 2.23E+01			3.35E+01 2.23E+01					
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.40 0.40			0.40 0.40			0.40 0.40					
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.9E+03	Normal	0.41	8.7E+03	Normal	0.40	8.7E+03	Normal	0.40	8.7E+03	Normal	0.40			
Embodied Energy (MJ)	8.4E+04	Normal	0.41	1.4E+05	Normal	0.40	1.4E+05	Normal	0.40	1.4E+05	Normal	0.40			
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			60% 0.50			40% 0.50			20% 0.50					

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification
NISTIR Name
Description

B1033.021b
Special Concentric Braced Frame w HSS braces, tapered gusset plates & design to AISC minimum standard, Chevron Brace, Brace 41 PLF < w < 99 PLF
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 27

Construction Quality:	Not Specified				
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1		Quantity Rounding Round Qty? YES		
Demand Parameter (unit):	Story Drift Ratio		Allow sum by floor or building? NO		
Number of Damage States:	4		Demand Location (floor above?) No		
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 time brace depth . Yielding and out-of-plane deformation of gusset . Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture . Significant yielding and local buckling in beams and columns adjacent to gusset .	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.	

Illustrations

none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.011a-DS3-2.JPG	
1.00	1.00	1.00	1.00	

Damage State Probability:	1.00	1.00	1.00	1.00	
Fragility Parameters					
Median Demand, θ :	0.0037	0.0075	0.0145	0.0199	
Data dispersion, β_d :	0.26	0.25	0.2	0.35	
Uncertainty, β_u :	0.1	0.1	0.1	0.1	
Total Dispersion, β :	0.3	0.25	0.25	0.35	
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Average	
Directionality (Yes / No)	YES	Data Relevance Superior		Rationality Superior	

Consequence Functions
Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.	Brace has lost significant axial capacity, and replacement of braces is likely required. Tapered gusset plates typically sustain greater damage and there is a higher probability that replacement will be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.	Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed	Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed
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Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.49E+04	3.61E+04	4.05E+04	2.58E+04	4.98E+04	5.98E+04	2.86E+04	5.33E+04	6.47E+04	2.86E+04	5.33E+04	6.47E+04			
Best fit mean:	3.05E+04			4.51E+04			4.88E+04			4.88E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.33E+04 2.89E+04			5.98E+04 3.99E+04			6.40E+04 4.27E+04			6.40E+04 4.27E+04					
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.29 0.29			0.29 0.29			0.29 0.29					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.83E+00	2.39E+01	2.68E+01	1.70E+01	3.30E+01	3.95E+01	1.89E+01	3.53E+01	4.28E+01	1.89E+01	3.53E+01	4.28E+01			
Best fit mean:	2.02E+01			2.99E+01			3.23E+01			3.23E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.87E+01 1.91E+01			3.96E+01 2.64E+01			4.23E+01 2.82E+01			4.23E+01 2.82E+01					
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.39 0.39			0.38 0.38			0.38 0.38					
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.9E+03	Normal	0.41	1.2E+04	Normal	0.39	1.2E+04	Normal	0.38	1.2E+04	Normal	0.38			
Embodied Energy (MJ)	8.4E+04	Normal	0.41	2.3E+05	Normal	0.39	2.3E+05	Normal	0.38	2.3E+05	Normal	0.38			
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			60% 0.50			40% 0.50			20% 0.50					

Comments:
Date Created:
Approved (YES / NO)?
Official (YES / NO) ?
Author:
Revisions:

None
Not Given
By User
By User
Not Given
2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.021c

NISTIR Name
Description

Special Concentric Braced Frame w HSS braces, tapered gusset plates & design to AISC minimum standard, Chevron Brace, Brace w > 100 PLF
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 28

Construction Quality:	Not Specified				
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1		Quantity Rounding Round Qty? YES		
Demand Parameter (unit):	Story Drift Ratio		Allow sum by floor or building? NO		
Number of Damage States:	4		Demand Location (floor above?) No		
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 time brace depth . Yielding and out-of-plane deformation of gusset . Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture . Significant yielding and local buckling in beams and columns adjacent to gusset .	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.	

Illustrations

none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.011a-DS3-2.JPG	
1.00	1.00	1.00	1.00	

Damage State Probability:					
Fragility Parameters					
Median Demand, δ :	0.0037	0.0075	0.0145	0.0199	
Data dispersion, β_d :	0.26	0.25	0.2	0.35	
Uncertainty, β_u :	0.1	0.1	0.1	0.1	
Total Dispersion, β :	0.3	0.25	0.25	0.35	
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Average	
Directionality (Yes / No)	YES	Data Relevance Superior		Rationality Superior	

Consequence Functions

Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness or straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. Tapered gusset plates typically sustain greater damage and there is a higher probability that replacement will be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.49E+04	3.61E+04	4.05E+04	3.47E+04	6.10E+04	7.54E+04	3.87E+04	6.60E+04	8.24E+04	3.87E+04	6.60E+04	8.24E+04			
Best fit mean:	3.05E+04			5.70E+04			6.23E+04			6.23E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.33E+04 2.89E+04			7.32E+04 4.88E+04			7.92E+04 5.28E+04			7.92E+04 5.28E+04					
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.28 0.28			0.27 0.27			0.27 0.27					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.83E+00	2.39E+01	2.68E+01	2.29E+01	4.04E+01	4.99E+01	2.56E+01	4.37E+01	5.45E+01	2.56E+01	4.37E+01	5.45E+01			
Best fit mean:	2.02E+01			3.77E+01			4.13E+01			4.13E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.87E+01 1.91E+01			4.84E+01 3.23E+01			5.24E+01 3.49E+01			5.24E+01 3.49E+01					
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.37 0.37			0.37 0.37			0.37 0.37					
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.9E+03	Normal	0.41	1.6E+04	Normal	0.37	1.6E+04	Normal	0.37	1.6E+04	Normal	0.37			
Embodied Energy (MJ)	8.4E+04	Normal	0.41	3.5E+05	Normal	0.37	3.5E+05	Normal	0.37	3.5E+05	Normal	0.37			
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			60% 0.50			40% 0.50			20% 0.50					

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification
NISTIR Name
Description

B1033.022a
Special Concentric Braced Frame w HSS braces, tapered gusset plates & design to AISC minimum standard Single Diagonal Brace, Brace w < 40 PLF
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 29

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift RatioUnit less				
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 time brace depth . Yielding and out-of-plane deformation of gusset . Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture . Significant yielding and local buckling in beams and columns adjacent to gusset .	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.	

Illustrations

				
none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.011a-DS3-2.JPG	
1.00	1.00	1.00	1.00	

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.0037	0.0075	0.0145	0.0199	
Data dispersion, β_d :	0.26	0.25	0.2	0.35	
Uncertainty, β_u :	0.1	0.1	0.1	0.1	
Total Dispersion, β :	0.3	0.25	0.25	0.35	
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Average	
Directionality (Yes / No)	YES	Data Relevance Superior		Rationality Superior	

Consequence Functions
Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. Tapered gusset plates typically sustain greater damage and there is a higher probability that replacement will be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.43E+04	3.53E+04	3.94E+04	1.73E+04	3.91E+04	4.47E+04	1.79E+04	3.99E+04	4.59E+04	1.79E+04	3.99E+04	4.59E+04			
Best fit mean:	2.96E+04			3.37E+04			3.46E+04			3.46E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.24E+04 2.83E+04			4.69E+04 3.13E+04			4.79E+04 3.19E+04			4.79E+04 3.19E+04					
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.32 0.32			0.32 0.32			0.32 0.32					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.44E+00	2.34E+01	2.60E+01	1.14E+01	2.59E+01	2.96E+01	1.18E+01	2.64E+01	3.03E+01	1.18E+01	2.64E+01	3.03E+01			
Best fit mean:	1.96E+01			2.23E+01			2.29E+01			2.29E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.80E+01 1.87E+01			3.10E+01 2.07E+01			3.17E+01 2.11E+01			3.17E+01 2.11E+01					
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.40 0.40			0.40 0.40			0.40 0.40					
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.9E+03	Normal	0.41	8.1E+03	Normal	0.40	7.8E+03	Normal	0.40	7.8E+03	Normal	0.40			
Embodied Energy (MJ)	8.4E+04	Normal	0.41	1.2E+05	Normal	0.40	1.1E+05	Normal	0.40	1.1E+05	Normal	0.40			
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			60% 0.50			40% 0.50			20% 0.50					

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification
NISTIR Name
Description

B1033.022b
Special Concentric Braced Frame w HSS braces, tapered gusset plates & design to AISC minimum standard, Single Diagonal Brace, Brace 41 PLF < w < 99 PLF
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 30

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift RatioUnit less				
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 time brace depth . Yielding and out-of-plane deformation of gusset . Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture . Significant yielding and local buckling in beams and columns adjacent to gusset .	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.	

Illustrations

none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.011a-DS3-2.JPG
1.00	1.00	1.00	1.00

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.0037	0.0075	0.0145	0.0199	
Data dispersion, β_d :	0.26	0.25	0.2	0.35	
Uncertainty, β_u :	0.1	0.1	0.1	0.1	
Total Dispersion, β :	0.3	0.25	0.25	0.35	
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Average	
Directionality (Yes / No)	YES	Data Relevance Superior		Rationality Superior	

Consequence Functions
Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. Tapered gusset plates typically sustain greater damage and there is a higher probability that replacement will be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.43E+04	3.53E+04	3.94E+04	2.17E+04	4.46E+04	5.25E+04	2.45E+04	4.81E+04	5.74E+04	2.45E+04	4.81E+04	5.74E+04			
Best fit mean:	2.96E+04			3.96E+04			4.33E+04			4.33E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.24E+04 2.83E+04			5.35E+04 3.57E+04			5.77E+04 3.85E+04			5.77E+04 3.85E+04					
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.30 0.30			0.30 0.30			0.30 0.30					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.44E+00	2.34E+01	2.60E+01	1.43E+01	2.95E+01	3.47E+01	1.62E+01	3.18E+01	3.80E+01	1.62E+01	3.18E+01	3.80E+01			
Best fit mean:	1.96E+01			2.62E+01			2.87E+01			2.87E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.80E+01 1.87E+01			3.54E+01 2.36E+01			3.82E+01 2.55E+01			3.82E+01 2.55E+01					
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.39 0.39			0.39 0.39			0.39 0.39					
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.9E+03	Normal	0.41	1.0E+04	Normal	0.39	1.0E+04	Normal	0.39	1.0E+04	Normal	0.39			
Embodied Energy (MJ)	8.4E+04	Normal	0.41	1.8E+05	Normal	0.39	1.8E+05	Normal	0.39	1.8E+05	Normal	0.39			
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			60% 0.50			40% 0.50			20% 0.50					

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification
NISTIR Name
Description

B1033.022c
Special Concentric Braced Frame w HSS braces, tapered gusset plates & design to AISC minimum standard, Single Diagonal Brace, Brace w > 100 PLF
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 31

Construction Quality:	Not Specified				
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1		Quantity Rounding Round Qty? YES		
Demand Parameter (unit):	Story Drift Ratio		Allow sum by floor or building? NO		
Number of Damage States:	4		Demand Location (floor above?) No		
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 time brace depth . Yielding and out-of-plane deformation of gusset . Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture . Significant yielding and local buckling in beams and columns adjacent to gusset .	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.	

Illustrations

none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.011a-DS3-2.JPG	
1.00	1.00	1.00	1.00	

Damage State Probability:	1.00	1.00	1.00	1.00	
Fragility Parameters					
Median Demand, θ :	0.0037	0.0075	0.0145	0.0199	
Data dispersion, β_d :	0.26	0.25	0.2	0.35	
Uncertainty, β_u :	0.1	0.1	0.1	0.1	
Total Dispersion, β :	0.3	0.25	0.25	0.35	
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Average	
Directionality (Yes / No)	YES	Data Relevance Superior		Rationality Superior	

Consequence Functions
Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. Tapered gusset plates typically sustain greater damage and there is a higher probability that replacement will be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.43E+04	3.53E+04	3.94E+04	2.75E+04	5.18E+04	6.25E+04	3.19E+04	5.73E+04	7.02E+04	3.19E+04	5.73E+04	7.02E+04			
Best fit mean:	2.96E+04			4.72E+04			5.31E+04			5.31E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.24E+04 2.83E+04			6.22E+04 4.15E+04			6.88E+04 4.59E+04			6.88E+04 4.59E+04					
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.29 0.29			0.28 0.28			0.28 0.28					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.44E+00	2.34E+01	2.60E+01	1.82E+01	3.43E+01	4.13E+01	2.11E+01	3.79E+01	4.64E+01	2.11E+01	3.79E+01	4.64E+01			
Best fit mean:	1.96E+01			3.13E+01			3.51E+01			3.51E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.80E+01 1.87E+01			4.11E+01 2.74E+01			4.55E+01 3.03E+01			4.55E+01 3.03E+01					
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.38 0.38			0.38 0.38			0.38 0.38					
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.9E+03	Normal	0.41	1.3E+04	Normal	0.38	1.3E+04	Normal	0.38	1.3E+04	Normal	0.38			
Embodied Energy (MJ)	8.4E+04	Normal	0.41	2.6E+05	Normal	0.38	2.6E+05	Normal	0.38	2.6E+05	Normal	0.38			
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			60% 0.50			40% 0.50			20% 0.50					

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification
NISTIR Name
Description

B1033.023a
Special Concentric Braced Frame w HSS braces, tapered gusset plates & design to AISC minimum standard, X Brace, Brace w < 40 PLF
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 32

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift RatioUnit less				
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)				
Descriptions	<p>Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.</p>	<p>Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.</p>	<p>Buckling of brace in excess of 2 time brace depth . Yielding and out-of-plane deformation of gusset . Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture . Significant yielding and local buckling in beams and columns adjacent to gusset .</p>	<p>Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.</p>	

Illustrations

				
none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.011a-DS3-2.JPG	
1.00	1.00	1.00	1.00	

Damage State Probability:	1.00	1.00	1.00	1.00	
Fragility Parameters					
Median Demand, θ :	0.0037	0.0075	0.0145	0.0199	
Data dispersion, β_d :	0.26	0.25	0.2	0.35	
Uncertainty, β_u :	0.1	0.1	0.1	0.1	
Total Dispersion, β :	0.3	0.25	0.25	0.35	
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Average	
Directionality (Yes / No)	YES	Data Relevance Superior		Rationality Superior	

Consequence Functions
Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. Tapered gusset plates typically sustain greater damage and there is a higher probability that replacement will be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

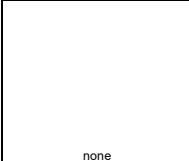



NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.56E+04	3.69E+04	4.17E+04	2.10E+04	4.37E+04	5.13E+04	2.22E+04	4.52E+04	5.34E+04	2.22E+04	4.52E+04	5.34E+04	2.22E+04	4.52E+04	5.34E+04
Best fit mean:	3.14E+04			3.87E+04			4.03E+04			4.03E+04			4.03E+04		
Best Fit Distribution:	Normal			Normal			Normal			Normal			Normal		
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00		
Average Repair Cost (Min Qty, Max Qty)	4.43E+04 2.95E+04			5.25E+04 3.50E+04			5.43E+04 3.62E+04			5.43E+04 3.62E+04			5.43E+04 3.62E+04		
CV or beta (Min Qty, Max Qty)	0.32 0.32			0.31 0.31			0.30 0.30			0.30 0.30			0.30 0.30		
Quantity Unit:	Each			Each			Each			Each			Each		
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.03E+01	2.44E+01	2.76E+01	1.39E+01	2.89E+01	3.39E+01	1.47E+01	2.99E+01	3.53E+01	1.47E+01	2.99E+01	3.53E+01	1.47E+01	2.99E+01	3.53E+01
Best fit mean:	2.08E+01			2.56E+01			2.66E+01			2.66E+01			2.66E+01		
Best Fit Distribution:	Normal			Normal			Normal			Normal			Normal		
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00		
Average Repair Time (Min Qty, Max Qty)	2.93E+01 1.95E+01			3.47E+01 2.32E+01			3.59E+01 2.40E+01			3.59E+01 2.40E+01			3.59E+01 2.40E+01		
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.40 0.40			0.39 0.39			0.39 0.39			0.39 0.39		
Quantity Unit:	Each			Each			Each			Each			Each		
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.9E+03	Normal	0.41	9.8E+03	Normal	0.40	9.8E+03	Normal	0.39	9.8E+03	Normal	0.39	9.8E+03	Normal	0.39
Embodied Energy (MJ)	8.4E+04	Normal	0.41	1.7E+05	Normal	0.40	1.7E+05	Normal	0.39	1.7E+05	Normal	0.39	1.7E+05	Normal	0.39
LifeSafety Hazard:	NO			NO			NO			NO			NO		
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO			NO		
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable			Not Applicable		
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00			0% 0.00		
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00			0% 0.00		
Post-event Tagging Flag:	NO			YES			YES			YES			YES		
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			60% 0.50			40% 0.50			20% 0.50			20% 0.50		

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification		B1033.023b				Line 33
NISTIR Name		Special Concentric Braced Frame w HSS braces, tapered gusset plates & design to AISC minimum standard, X Brace, Brace 41 PLF < w < 99 PLF				
Description		Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.				
Construction Quality:		Not Specified				
Seismic Installation Conditions:		Not Specified				
Fragility Unit of Measure:		EA 1				Quantity Rounding Round Qty? YES
Demand Parameter (unit):		Story Drift Ratio				Allow sum by floor or building? NO
Number of Damage States:		4				Demand Location (floor above?) No
Damage State:		DS1	DS2	DS3	DS4	
Type of Damage State:		Sequential	Sequential	Sequential	Sequential	
DS Hierarchy		Seq(DS1,DS2,DS3,DS4)				
Descriptions		Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 time brace depth . Yielding and out-of-plane deformation of gusset . Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture . Significant yielding and local buckling in beams and columns adjacent to gusset .	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.	
Illustrations						
Damage State Probability:		1.00	1.00	1.00	1.00	
Fragility Parameters						
Median Demand, θ :		0.0037	0.0075	0.0145	0.0199	
Data dispersion, β_d :		0.26	0.25	0.2	0.35	
Uncertainty, β_u :		0.1	0.1	0.1	0.1	
Total Dispersion, β :		0.3	0.25	0.25	0.35	
Correlation (Yes / No)		NO	Data Quality Superior		Documentation Quality Average	
Directionality (Yes / No)		YES	Data Relevance Superior		Rationality Superior	
Consequence Functions						
Repair Description		Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness or straightening or repair may be desirable aesthetic reasons.	Brace has lost significant axial capacity, and replacement of braces is likely required. Tapered gusset plates typically sustain greater damage and there is a higher probability that replacement will be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.	Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed	Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed	
Long Lead Time (Yes / No)		NO	NO	NO	NO	
Repair Costs:		P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}
Repair Cost by Damage State:		1.56E+04 3.69E+04 4.17E+04	3.16E+04 5.70E+04 6.98E+04	3.44E+04 6.05E+04 7.47E+04	3.44E+04 6.05E+04 7.47E+04	
Best fit mean:		3.14E+04	5.28E+04	5.65E+04	5.65E+04	
Best Fit Distribution:		Normal	Normal	Normal	Normal	
Quantity Plateau (Min Qty, Max Qty)		5.00 20.00	5.00 20.00	5.00 20.00	5.00 20.00	
Average Repair Cost (Min Qty, Max Qty)		4.43E+04 2.95E+04	6.83E+04 4.56E+04	7.25E+04 4.84E+04	7.25E+04 4.84E+04	
CV or beta (Min Qty, Max Qty)		0.32 0.32	0.28 0.28	0.28 0.28	0.28 0.28	
Quantity Unit:		Each	Each	Each	Each	
Repair Time:		P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}
Repair Time by Damage State:		1.03E+01 2.44E+01 2.76E+01	2.09E+01 3.77E+01 4.62E+01	2.27E+01 4.00E+01 4.94E+01	2.27E+01 4.00E+01 4.94E+01	
Best fit mean:		2.08E+01	3.49E+01	3.74E+01	3.74E+01	
Best Fit Distribution:		Normal	Normal	Normal	Normal	
Quantity Plateau (Min Qty, Max Qty)		5.00 20.00	5.00 20.00	5.00 20.00	5.00 20.00	
Average Repair Time (Min Qty, Max Qty)		2.93E+01 1.95E+01	4.52E+01 3.02E+01	4.80E+01 3.20E+01	4.80E+01 3.20E+01	
CV or beta (Min Qty, Max Qty)		0.41 0.41	0.38 0.38	0.37 0.37	0.37 0.37	
Quantity Unit:		Each	Each	Each	Each	
Environmental Impacts:		Median Cost Best Fit CV or Beta	Median Cost Best Fit CV or Beta	Median Cost Best Fit CV or Beta	Median Cost Best Fit CV or Beta	Median Cost Best Fit CV or Beta
Embodied Carbon (kg CO2eq)		6.9E+03 Normal 0.41	1.5E+04 Normal 0.38	1.5E+04 Normal 0.37	1.5E+04 Normal 0.37	
Embodied Energy (MJ)		8.4E+04 Normal 0.41	3.1E+05 Normal 0.38	3.1E+05 Normal 0.37	3.1E+05 Normal 0.37	
LifeSafety Hazard:						
Potential non-collapse casualties? (Yes / No)		NO	NO	NO	NO	
Casualty-affected Planar Area (sf) per Normative Unit:		Not Applicable	Not Applicable	Not Applicable	Not Applicable	
Serious Injury (Median, Dispersion)		0% 0.00	0% 0.00	0% 0.00	0% 0.00	
Loss of Life (Median, Dispersion)		0% 0.00	0% 0.00	0% 0.00	0% 0.00	
Post-event Tagging Flag:		NO	YES	YES	YES	
Unsafe Placard Trigger (Median, Dispersion)		0% 0.00	60% 0.50	40% 0.50	20% 0.50	
Comments:		None				
Date Created:		Not Given				Root Cost Multiplier: 1
Approved (YES / NO)?		By User				Date Generated: 02/26/19
Official (YES / NO) ?		By User				
Author:		Not Given				
Revisions:		2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.				

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.023c

NISTIR Name

Special Concentric Braced Frame w HSS braces, tapered gusset plates & design to AISC minimum standard, X Brace, Brace w > 100 PLF

Description

Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 34

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding Round Qty? YES

Allow sum by floor or building? NO

Demand Location (floor above?) No

Number of Damage States:

4

Damage State:

DS1

DS2

DS3

DS4

Type of Damage State:

Sequential

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3,DS4)

Descriptions

Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.

Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.

Buckling of brace in excess of 2 time brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.

Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.

Illustrations



none

B1033.001a-DS2-1.JPG

B1033.001a-DS3-1.JPG

B1033.011a-DS3-2.JPG

Damage State Probability:

1.00

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.0037

0.0075

0.0145

0.0199

Data dispersion, β_d :

0.26

0.25

0.2

0.35

Uncertainty, β_u :

0.1

0.1

0.1

0.1

Total Dispersion, β :

0.3

0.25

0.25

0.35

Correlation (Yes / No)

NO

Data Quality Superior

Documentation Quality Average

Directionality (Yes / No)

YES

Data Relevance Superior

Rationality Superior

Consequence Functions

Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness or straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. Tapered gusset plates typically sustain greater damage and there is a higher probability that replacement will be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.56E+04	3.69E+04	4.17E+04	4.37E+04	7.22E+04	9.11E+04	4.81E+04	7.77E+04	9.88E+04	4.81E+04	7.77E+04	9.88E+04			
Best fit mean:	3.14E+04			6.90E+04			7.48E+04			7.48E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00			3.00			10.00		
Average Repair Cost (Min Qty, Max Qty)	4.06E+04			7.94E+04			8.54E+04			8.54E+04			6.99E+04		
CV or beta (Min Qty, Max Qty)	0.32			0.27			0.26			0.26			0.26		
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.03E+01	2.44E+01	2.76E+01	2.89E+01	4.78E+01	6.03E+01	3.18E+01	5.14E+01	6.54E+01	3.18E+01	5.14E+01	6.54E+01			
Best fit mean:	2.08E+01			4.56E+01			4.95E+01			4.95E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00			3.00			10.00		
Average Repair Time (Min Qty, Max Qty)	2.69E+01			5.25E+01			5.65E+01			5.65E+01			4.63E+01		
CV or beta (Min Qty, Max Qty)	0.41			0.37			0.36			0.36			0.36		
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	6.9E+03	Normal	0.41	2.0E+04	Normal	0.37	2.0E+04	Normal	0.36	2.0E+04	Normal	0.36			
Embodied Energy (MJ)	8.4E+04	Normal	0.41	4.7E+05	Normal	0.37	4.7E+05	Normal	0.36	4.7E+05	Normal	0.36			
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0%			0%			0%			0%			0%		
Loss of Life (Median, Dispersion)	0%			0%			0%			0%			0%		
Post-event Tagging Flag:															
Unsafe Placard Trigger (Median, Dispersion)	NO			YES			YES			YES					
	0%			60%			40%			20%			0%		

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Root Cost Multiplier: 1

Official (YES / NO) ?

By User

Date Generated: 02/26/19

Author:

Not Given

Revisions:

2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

FEMA P-58 Fragility Specification

NISTIR ClassificationB1033.031a

NISTIR NameSpecial Concentric Braced Frame, design to AISC minimum standards, Chevron Brace, Brace w < 40 PLF

DescriptionCosting is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 35

Construction Quality:	Not Specified			
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Story Drift Ratio Unit less			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 time brace depth . Yielding and out-of-plane deformation of gusset . Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture . Significant yielding and local buckling in beams and columns adjacent to gusset .	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0074	0.0121	0.0152		
Data dispersion, β_d :	0.3	0.25	0.35		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.3	0.25	0.35		
Correlation (Yes / No)	NO	Data Quality Superior	Documentation Quality Superior		
Directionality (Yes / No)	YES	Data Relevance Superior	Rationality Superior		

Consequence Functions			
Repair Description	Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.	Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.	Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.49E+04	3.61E+04	4.05E+04	1.84E+04	4.05E+04	4.66E+04	1.98E+04	4.22E+04	4.90E+04						
Best fit mean:	3.05E+04			3.51E+04			3.70E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00								
Average Repair Cost (Min Qty, Max Qty)	3.97E+04 3.25E+04			4.45E+04 3.64E+04			4.64E+04 3.80E+04								
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.31 0.31			0.31 0.31								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.83E+00	2.39E+01	2.68E+01	1.22E+01	2.68E+01	3.08E+01	1.31E+01	2.79E+01	3.24E+01						
Best fit mean:	2.02E+01			2.32E+01			2.45E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00								
Average Repair Time (Min Qty, Max Qty)	2.63E+01 2.15E+01			2.95E+01 2.41E+01			3.07E+01 2.51E+01								
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.40 0.40			0.40 0.40								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.9E+03	Normal	0.41	8.7E+03	Normal	0.40	8.7E+03	Normal	0.40						
Embodied Energy (MJ)	8.4E+04	Normal	0.41	1.4E+05	Normal	0.40	1.4E+05	Normal	0.40						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	YES			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	60% 0.50			40% 0.50			20% 0.50								

Comments:None

Date Created:Not Given

Approved (YES / NO)?By User

Official (YES / NO) ?By User

Author:Not Given

Revisions:2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier:1

Date Generated:02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.031b

NISTIR Name

Special Concentric Braced Frame, design to AISC minimum standards, Chevron Brace, Brace 41 PLF < w < 99 PLF
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset.
Initiation of cracking of welds of gusset.
Initiation of yielding in beams and columns adjacent to gusset.

Buckling of brace in excess of 2 time brace depth . Yielding and out-of-plane deformation of gusset . Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture . Significant yielding and local buckling in beams and columns adjacent to gusset .

Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.

Quantity Rounding

Round Qty? YES

Allow sum by floor or building? NO

Demand Location (floor above?) No

Illustrations



Damage State Probability:

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.0074

0.0121

0.0152

Data dispersion, β_d :

0.3

0.25

0.35

Uncertainty, β_u :

0.1

0.1

0.1

Total Dispersion, β :

0.3

0.25

0.35

Correlation (Yes / No)

NO

Data Quality Superior

Documentation Quality Superior

Directionality (Yes / No)

YES

Data Relevance Superior

Rationality Superior

Consequence Functions

Repair Description

Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.49E+04	3.61E+04	4.05E+04	2.58E+04	4.98E+04	5.98E+04	2.86E+04	5.33E+04	6.47E+04						
Best fit mean:	3.05E+04			4.51E+04			4.88E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00								
Average Repair Cost (Min Qty, Max Qty)	3.97E+04 3.25E+04			5.48E+04 4.48E+04			5.87E+04 4.80E+04								
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.29 0.29			0.29 0.29								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.83E+00	2.39E+01	2.68E+01	1.70E+01	3.30E+01	3.95E+01	1.89E+01	3.53E+01	4.28E+01						
Best fit mean:	2.02E+01			2.99E+01			3.23E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00								
Average Repair Time (Min Qty, Max Qty)	2.63E+01 2.15E+01			3.63E+01 2.97E+01			3.88E+01 3.18E+01								
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.39 0.39			0.38 0.38								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.9E+03	Normal	0.41	1.2E+04	Normal	0.39	1.2E+04	Normal	0.38						
Embodied Energy (MJ)	8.4E+04	Normal	0.41	2.3E+05	Normal	0.39	2.3E+05	Normal	0.38						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	YES			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	60% 0.50			40% 0.50			20% 0.50								

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR ClassificationB1033.031c

NISTIR NameSpecial Concentric Braced Frame, design to AISC minimum standards, Chevron Brace, Brace w > 100 PLF

DescriptionCosting is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 37

Construction Quality:	Not Specified			
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Story Drift Ratio Unit less			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 time brace depth . Yielding and out-of-plane deformation of gusset . Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture . Significant yielding and local buckling in beams and columns adjacent to gusset .	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0074	0.0121	0.0152		
Data dispersion, β_d :	0.3	0.25	0.35		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.3	0.25	0.35		
Correlation (Yes / No)	NO	Data Quality Superior	Documentation Quality Superior		
Directionality (Yes / No)	YES	Data Relevance Superior	Rationality Superior		

Consequence Functions			
Repair Description	Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.	Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.	Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.49E+04	3.61E+04	4.05E+04	3.47E+04	6.10E+04	7.54E+04	3.87E+04	6.60E+04	8.24E+04						
Best fit mean:	3.05E+04			5.70E+04			6.23E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00								
Average Repair Cost (Min Qty, Max Qty)	3.97E+04 3.25E+04			6.71E+04 5.49E+04			7.26E+04 5.94E+04								
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.28 0.28			0.27 0.27								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.83E+00	2.39E+01	2.68E+01	2.29E+01	4.04E+01	4.99E+01	2.56E+01	4.37E+01	5.45E+01						
Best fit mean:	2.02E+01			3.77E+01			4.13E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00								
Average Repair Time (Min Qty, Max Qty)	2.63E+01 2.15E+01			4.44E+01 3.63E+01			4.80E+01 3.93E+01								
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.37 0.37			0.37 0.37								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.9E+03	Normal	0.41	1.6E+04	Normal	0.37	1.6E+04	Normal	0.37						
Embodied Energy (MJ)	8.4E+04	Normal	0.41	3.5E+05	Normal	0.37	3.5E+05	Normal	0.37						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	YES			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	60% 0.50			40% 0.50			20% 0.50								

Comments:None

Date Created:Not Given

Approved (YES / NO)?By User

Official (YES / NO) ?By User

Author:Not Given

Revisions:2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier:1

Date Generated:02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.032a

NISTIR Name

Special Concentric Braced Frame, design to AISC minimum standards, Single Diagonal Brace, Brace w < 40 PLF

Description

Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 38

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.

Buckling of brace in excess of 2 time brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.

Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Illustrations



Damage State Probability:

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.0074

0.0121

0.0152

Data dispersion, β_d :

0.3

0.25

0.35

Uncertainty, β_u :

0.1

0.1

0.1

Total Dispersion, β :

0.3

0.25

0.35

Correlation (Yes / No)

NO

Data Quality Superior

Documentation Quality Superior

Directionality (Yes / No)

YES

Data Relevance Superior

Rationality Superior

Consequence Functions

Repair Description

Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.43E+04	3.53E+04	3.94E+04	1.73E+04	3.91E+04	4.47E+04	1.79E+04	3.99E+04	4.59E+04						
Best fit mean:	2.96E+04			3.37E+04			3.46E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00								
Average Repair Cost (Min Qty, Max Qty)	3.89E+04 3.18E+04			4.30E+04 3.52E+04			4.39E+04 3.59E+04								
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.32 0.32			0.32 0.32								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.44E+00	2.34E+01	2.60E+01	1.14E+01	2.59E+01	2.96E+01	1.18E+01	2.64E+01	3.03E+01						
Best fit mean:	1.96E+01			2.23E+01			2.29E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00								
Average Repair Time (Min Qty, Max Qty)	2.57E+01 2.10E+01			2.84E+01 2.33E+01			2.91E+01 2.38E+01								
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.40 0.40			0.40 0.40								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.9E+03	Normal	0.41	8.1E+03	Normal	0.40	7.8E+03	Normal	0.40						
Embodied Energy (MJ)	8.4E+04	Normal	0.41	1.2E+05	Normal	0.40	1.1E+05	Normal	0.40						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	YES			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	60% 0.50			40% 0.50			20% 0.50								

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.032b

NISTIR Name

Special Concentric Braced Frame, design to AISC minimum standards, Single Diagonal Brace, Brace 41 PLF < w < 99 PLF

Description

Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 39

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.

Buckling of brace in excess of 2 time brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.

Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Illustrations



Damage State Probability:

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.0074

0.0121

0.0152

Data dispersion, β_d :

0.3

0.25

0.35

Uncertainty, β_u :

0.1

0.1

0.1

Total Dispersion, β :

0.3

0.25

0.35

Correlation (Yes / No)

NO

Data Quality Superior

Documentation Quality Superior

Directionality (Yes / No)

YES

Data Relevance Superior

Rationality Superior

Consequence Functions

Repair Description

Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.43E+04	3.53E+04	3.94E+04	2.17E+04	4.46E+04	5.25E+04	2.45E+04	4.81E+04	5.74E+04						
Best fit mean:	2.96E+04			3.96E+04			4.33E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00								
Average Repair Cost (Min Qty, Max Qty)	3.89E+04 3.18E+04			4.91E+04 4.02E+04			5.29E+04 4.33E+04								
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.30 0.30			0.30 0.30								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.44E+00	2.34E+01	2.60E+01	1.43E+01	2.95E+01	3.47E+01	1.62E+01	3.18E+01	3.80E+01						
Best fit mean:	1.96E+01			2.62E+01			2.87E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00								
Average Repair Time (Min Qty, Max Qty)	2.57E+01 2.10E+01			3.25E+01 2.66E+01			3.50E+01 2.87E+01								
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.39 0.39			0.39 0.39								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.9E+03	Normal	0.41	1.0E+04	Normal	0.39	1.0E+04	Normal	0.39						
Embodied Energy (MJ)	8.4E+04	Normal	0.41	1.8E+05	Normal	0.39	1.8E+05	Normal	0.39						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	YES			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	60% 0.50			40% 0.50			20% 0.50								

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Root Cost Multiplier: 1

Official (YES / NO) ?

By User

Date Generated: 02/26/19

Author:

Not Given

Revisions:

2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.032c

NISTIR Name

Special Concentric Braced Frame, design to AISC minimum standards, Single Diagonal Brace, Brace w > 100 PLF
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset.
Initiation of cracking of welds of gusset.
Initiation of yielding in beams and columns adjacent to gusset.

Buckling of brace in excess of 2 time brace depth . Yielding and out-of-plane deformation of gusset . Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture . Significant yielding and local buckling in beams and columns adjacent to gusset .

Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.

Quantity Rounding

Round Qty? YES

Allow sum by floor or building? NO

Demand Location (floor above?) No

Illustrations



Damage State Probability:

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.0074

0.0121

0.0152

Data dispersion, β_d :

0.3

0.25

0.35

Uncertainty, β_u :

0.1

0.1

0.1

Total Dispersion, β :

0.3

0.25

0.35

Correlation (Yes / No)

NO

Directionality (Yes / No)

YES

Data Quality Superior

Data Relevance Superior

Documentation Quality Superior

Rationality Superior

Consequence Functions

Repair Description

Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.43E+04	3.53E+04	3.94E+04	2.75E+04	5.18E+04	6.25E+04	3.19E+04	5.73E+04	7.02E+04						
Best fit mean:	2.96E+04			4.72E+04			5.31E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00								
Average Repair Cost (Min Qty, Max Qty)	3.89E+04 3.18E+04			5.70E+04 4.66E+04			6.30E+04 5.16E+04								
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.29 0.29			0.28 0.28								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.44E+00	2.34E+01	2.60E+01	1.82E+01	3.43E+01	4.13E+01	2.11E+01	3.79E+01	4.64E+01						
Best fit mean:	1.96E+01			3.13E+01			3.51E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00								
Average Repair Time (Min Qty, Max Qty)	2.57E+01 2.10E+01			3.77E+01 3.09E+01			4.17E+01 3.41E+01								
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.38 0.38			0.38 0.38								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.9E+03	Normal	0.41	1.3E+04	Normal	0.38	1.3E+04	Normal	0.38						
Embodied Energy (MJ)	8.4E+04	Normal	0.41	2.6E+05	Normal	0.38	2.6E+05	Normal	0.38						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	YES			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	60% 0.50			40% 0.50			20% 0.50								

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification
NISTIR Name
Description

B1033.033a
Special Concentric Braced Frame, design to AISC minimum standards, X Brace, Brace w < 40 PLF
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 41

Construction Quality:	Not Specified				Quantity Rounding Round Qty? YES Allow sum by floor or building? NO Demand Location (floor above)? No
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio Unit less				
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)				
Descriptions	<div><div>Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.</div><div>Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.</div><div>Buckling of brace in excess of 2 times brace depth . Yielding and out-of-plane deformation of gusset . Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset .</div><div>Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibly local buckling and cracking in the yielded areas.</div></div>				

Illustrations

				
none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.011a-DS3-2.JPG	
1.00	1.00	1.00	1.00	

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.0038	0.0075	0.0145	0.0185	
Data dispersion, β_d :	0.29	0.50	0.1	0.25	
Uncertainty, β_u :	0.1	0.25	0.25	0.25	
Total Dispersion, β :	0.3	0.55	0.25	0.35	
Correlation (Yes / No)	NO	Data Quality Marginal		Documentation Quality Marginal	
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Average	

Consequence Functions
Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.56E+04	3.69E+04	4.17E+04	2.10E+04	4.37E+04	5.13E+04	2.22E+04	4.52E+04	5.34E+04	2.22E+04	4.52E+04	5.34E+04	2.22E+04	4.52E+04	5.34E+04
Best fit mean:	3.14E+04			3.87E+04			4.03E+04			4.03E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00			3.00 10.00					
Average Repair Cost (Min Qty, Max Qty)	4.06E+04 3.32E+04			4.81E+04 3.94E+04			4.98E+04 4.07E+04			4.98E+04 4.07E+04					
CV or beta (Min Qty, Max Qty)	0.32 0.32			0.31 0.31			0.30 0.30			0.30 0.30					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.03E+01	2.44E+01	2.76E+01	1.39E+01	2.89E+01	3.39E+01	1.47E+01	2.99E+01	3.53E+01	1.47E+01	2.99E+01	3.53E+01	1.47E+01	2.99E+01	3.53E+01
Best fit mean:	2.08E+01			2.56E+01			2.66E+01			2.66E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00			3.00 10.00					
Average Repair Time (Min Qty, Max Qty)	2.69E+01 2.20E+01			3.18E+01 2.61E+01			3.29E+01 2.69E+01			3.29E+01 2.69E+01					
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.40 0.40			0.39 0.39			0.39 0.39					
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.9E+03	Normal	0.41	9.8E+03	Normal	0.40	9.8E+03	Normal	0.39	9.8E+03	Normal	0.39			
Embodied Energy (MJ)	8.4E+04	Normal	0.41	1.7E+05	Normal	0.40	1.7E+05	Normal	0.39	1.7E+05	Normal	0.39			
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			60% 0.50			40% 0.50			20% 0.50					

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.033b

NISTIR Name

Special Concentric Braced Frame, design to AISC minimum standards, X Brace, Brace 41 PLF < w < 99 PLF

Description

Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 42

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Number of Damage States:

4

Damage State:

DS1

DS2

DS3

DS4

Type of Damage State:

Sequential

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3,DS4)

Descriptions

Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.

Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.

Buckling of brace in excess of 2 times brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.

Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibly local buckling and cracking in the yielded areas.

Illustrations



Damage State Probability:

none

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.0038

0.0075

0.0145

0.0185

Data dispersion, β_d :

0.29

0.50

0.1

0.25

Uncertainty, β_u :

0.1

0.25

0.25

0.25

Total Dispersion, β :

0.3

0.55

0.25

0.35

Correlation (Yes / No)

NO

Data Quality Marginal

Documentation Quality Marginal

Directionality (Yes / No)

YES

Data Relevance Average

Rationality Average

Consequence Functions

Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.56E+04	3.69E+04	4.17E+04	3.16E+04	5.70E+04	6.98E+04	3.44E+04	6.05E+04	7.47E+04	3.44E+04	6.05E+04	7.47E+04			
Best fit mean:	3.14E+04			5.28E+04			5.65E+04			5.65E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00			3.00					
Average Repair Cost (Min Qty, Max Qty)	4.06E+04			6.27E+04			6.65E+04			6.65E+04					
CV or beta (Min Qty, Max Qty)	0.32			0.28			0.28			0.28					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.03E+01	2.44E+01	2.76E+01	2.09E+01	3.77E+01	4.62E+01	2.27E+01	4.00E+01	4.94E+01	2.27E+01	4.00E+01	4.94E+01			
Best fit mean:	2.08E+01			3.49E+01			3.74E+01			3.74E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00			3.00					
Average Repair Time (Min Qty, Max Qty)	2.69E+01			4.15E+01			4.40E+01			4.40E+01					
CV or beta (Min Qty, Max Qty)	0.41			0.38			0.37			0.37					
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	6.9E+03	Normal	0.41	1.5E+04	Normal	0.38	1.5E+04	Normal	0.37	1.5E+04	Normal	0.37			
Embodied Energy (MJ)	8.4E+04	Normal	0.41	3.1E+05	Normal	0.38	3.1E+05	Normal	0.37	3.1E+05	Normal	0.37			
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0%			0%			0%			0%					
Loss of Life (Median, Dispersion)	0%			0%			0%			0%					
Post-event Tagging Flag:	NO			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	0%			60%			40%			20%					

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification
NISTIR Name
Description

B1033.033c
Special Concentric Braced Frame, design to AISC minimum standards, X Brace, Brace w > 100 PLF
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 43

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift RatioUnit less				
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.		Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.		Buckling of brace in excess of 2 times brace depth . Yielding and out-of-plane deformation of gusset . Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture . Significant yielding and local buckling in beams and columns adjacent to gusset .
					Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibly local buckling and cracking in the yielded areas.

Illustrations

				
none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.011a-DS3-2.JPG	
1.00	1.00	1.00	1.00	

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.0038	0.0075	0.0145	0.0185	
Data dispersion, β_d :	0.29	0.50	0.1	0.25	
Uncertainty, β_u :	0.1	0.25	0.25	0.25	
Total Dispersion, β :	0.3	0.55	0.25	0.35	
Correlation (Yes / No)	NO	Data Quality Marginal		Documentation Quality Marginal	
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Average	

Consequence Functions
Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.56E+04	3.69E+04	4.17E+04	4.37E+04	7.22E+04	9.11E+04	4.81E+04	7.77E+04	9.88E+04	4.81E+04	7.77E+04	9.88E+04			
Best fit mean:	3.14E+04			6.90E+04			7.48E+04			7.48E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.98E+04 2.77E+04			9.74E+04 5.41E+04			1.05E+05 5.82E+04			1.05E+05 5.82E+04					
CV or beta (Min Qty, Max Qty)	0.32 0.32			0.27 0.27			0.26 0.26			0.26 0.26					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.03E+01	2.44E+01	2.76E+01	2.89E+01	4.78E+01	6.03E+01	3.18E+01	5.14E+01	6.54E+01	3.18E+01	5.14E+01	6.54E+01			
Best fit mean:	2.08E+01			4.56E+01			4.95E+01			4.95E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	3.30E+01 1.83E+01			6.45E+01 3.58E+01			6.94E+01 3.85E+01			6.94E+01 3.85E+01					
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.37 0.37			0.36 0.36			0.36 0.36					
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.9E+03	Normal	0.41	2.0E+04	Normal	0.37	2.0E+04	Normal	0.36	2.0E+04	Normal	0.36			
Embodied Energy (MJ)	8.4E+04	Normal	0.41	4.7E+05	Normal	0.37	4.7E+05	Normal	0.36	4.7E+05	Normal	0.36			
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			60% 0.50			40% 0.50			20% 0.50					

Comments: None

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Not Given

Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.041a

NISTIR Name
Description

Special Concentric Braced Frame w double angle braces, Chevron Brace, Brace w < 40 PLF
Costing on a per bay basis, equivalent to AISC minimum SCBF criteria. Costing does not include fireproofing removal or reapplication cost.

Line 44

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.		

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, δ :	0.00256	0.0048	0.0112		
Data dispersion, β_d :	0.28	0.30	0.5		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.3	0.3	0.3		
Correlation (Yes / No)	NO	Data Quality Marginal	Documentation Quality Marginal		
Directionality (Yes / No)	YES	Data Relevance Average	Rationality Average		

Consequence Functions
Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.49E+04	3.61E+04	4.05E+04	1.89E+04	4.12E+04	4.76E+04	2.03E+04	4.29E+04	5.00E+04						
Best fit mean:	3.05E+04			3.59E+04			3.77E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	4.87E+04 2.71E+04			5.56E+04 3.09E+04			5.79E+04 3.22E+04								
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.31 0.31			0.31 0.31								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.83E+00	2.39E+01	2.68E+01	1.25E+01	2.73E+01	3.15E+01	1.34E+01	2.84E+01	3.31E+01						
Best fit mean:	2.02E+01			2.37E+01			2.49E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	3.22E+01 1.79E+01			3.68E+01 2.04E+01			3.83E+01 2.13E+01								
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.40 0.40			0.40 0.40								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.9E+03	Normal	0.41	8.9E+03	Normal	0.40	8.9E+03	Normal	0.40						
Embodied Energy (MJ)	8.4E+04	Normal	0.41	1.4E+05	Normal	0.40	1.4E+05	Normal	0.40						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		60%	0.50		40%	0.50							

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.041b

NISTIR Name

Special Concentric Braced Frame w double angle braces, Chevron Brace, Brace 41 PLF < w < 99 PLF

Description

Costing on a per bay basis, equivalent to AISC minimum SCBF criteria. Costing does not include fireproofing removal or reapplication cost.

Line 45

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding Round Qty? YES

Allow sum by floor or building? NO

Demand Location (floor above?) No

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.

Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.

Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:

Fragility Parameters

Median Demand, θ :

0.00256

0.0048

0.0112

Data dispersion, β_d :

0.28

0.30

0.5

Uncertainty, β_u :

0.1

0.1

0.1

Total Dispersion, β :

0.3

0.3

0.3

Correlation (Yes / No)

NO

Data Quality Marginal

Documentation Quality Marginal

Directionality (Yes / No)

YES

Data Relevance Average

Rationality Average

Consequence Functions

Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Cost by Damage State:	1.49E+04	3.61E+04	4.05E+04	2.72E+04	5.15E+04	6.21E+04	3.00E+04	5.50E+04	6.70E+04						
Best fit mean:	3.05E+04			4.69E+04			5.06E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	4.87E+04 2.71E+04			6.95E+04 3.86E+04			7.42E+04 4.12E+04								
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.29 0.29			0.29 0.29								
Quantity Unit:	Each			Each			Each								
Repair Time:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Time by Damage State:	9.83E+00	2.39E+01	2.68E+01	1.80E+01	3.41E+01	4.11E+01	1.98E+01	3.64E+01	4.43E+01						
Best fit mean:	2.02E+01			3.10E+01			3.35E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	3.22E+01 1.79E+01			4.60E+01 2.55E+01			4.91E+01 2.73E+01								
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.38 0.38			0.38 0.38								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.9E+03	Normal	0.41	1.3E+04	Normal	0.38	1.3E+04	Normal	0.38						
Embodied Energy (MJ)	8.4E+04	Normal	0.41	2.5E+05	Normal	0.38	2.5E+05	Normal	0.38						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			60% 0.50			40% 0.50								

Comments:

None

Date Created:

Not Given

Root Cost Multiplier: 1

Approved (YES / NO)?

By User

Date Generated: 02/26/19

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.041c

NISTIR Name
Description

Special Concentric Braced Frame w double angle braces, Chevron Brace, Brace w > 100 PLF
Costing on a per bay basis, equivalent to AISC minimum SCBF criteria. Costing does not include fireproofing removal or reapplication cost.

Line 46

Construction Quality:	Not Specified					<div>Quantity RoundingRound Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	EA 1					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	3					
Damage State:	DS1	DS2	DS3			
Type of Damage State:	Sequential	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2,DS3)					
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.			

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.00256	0.0048	0.0112		
Data dispersion, β_d :	0.28	0.30	0.5		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.3	0.3	0.3		
Correlation (Yes / No)	NO	Data Quality Marginal	Documentation Quality Marginal		
Directionality (Yes / No)	YES	Data Relevance Average	Rationality Average		

Consequence Functions

Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.49E+04	3.61E+04	4.05E+04	3.70E+04	6.38E+04	7.94E+04	4.10E+04	6.88E+04	8.64E+04						
Best fit mean:	3.05E+04			6.00E+04			6.54E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00								
Average Repair Cost (Min Qty, Max Qty)	4.33E+04			7.66E+04			8.26E+04								
CV or beta (Min Qty, Max Qty)	0.33			0.28			0.27								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.83E+00	2.39E+01	2.68E+01	2.45E+01	4.22E+01	5.25E+01	2.71E+01	4.55E+01	5.72E+01						
Best fit mean:	2.02E+01			3.97E+01			4.33E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00								
Average Repair Time (Min Qty, Max Qty)	2.87E+01			5.07E+01			5.46E+01								
CV or beta (Min Qty, Max Qty)	0.41			0.37			0.37								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.9E+03	Normal	0.41	1.7E+04	Normal	0.37	1.7E+04	Normal	0.37						
Embodied Energy (MJ)	8.4E+04	Normal	0.41	3.8E+05	Normal	0.37	3.8E+05	Normal	0.37						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		60%	0.50		40%	0.50							

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.042a

NISTIR Name
Description

Special Concentric Braced Frame w double angle braces, Single Diagonal Brace, Brace w < 40 PLF
Costing on a per bay basis, equivalent to AISC minimum SCBF criteria. Costing does not include fireproofing removal or reapplication cost.

Line 47

Construction Quality: Not Specified
Seismic Installation Conditions: Not Specified

Fragility Unit of Measure:	EA 1
Demand Parameter (unit):	Story Drift Ratio
Number of Damage States:	3

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.		

Illustrations

none	none	none			
1.00	1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.00256	0.0048	0.0112		
Data dispersion, β_d :	0.28	0.30	0.5		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.3	0.3	0.3		
Correlation (Yes / No)	NO	Data Quality Marginal	Documentation Quality Marginal		
Directionality (Yes / No)	YES	Data Relevance Average	Rationality Average		

Consequence Functions
Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.43E+04	3.53E+04	3.94E+04	1.77E+04	3.96E+04	4.54E+04	1.83E+04	4.04E+04	4.66E+04						
Best fit mean:	2.96E+04			3.42E+04			3.51E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00								
Average Repair Cost (Min Qty, Max Qty)	4.24E+04			4.75E+04			4.85E+04								
CV or beta (Min Qty, Max Qty)	0.33			0.32			0.31								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.44E+00	2.34E+01	2.60E+01	1.17E+01	2.62E+01	3.00E+01	1.21E+01	2.67E+01	3.08E+01						
Best fit mean:	1.96E+01			2.26E+01			2.32E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00								
Average Repair Time (Min Qty, Max Qty)	2.80E+01			3.14E+01			3.21E+01								
CV or beta (Min Qty, Max Qty)	0.41			0.40			0.40								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.9E+03	Normal	0.41	8.3E+03	Normal	0.40	8.0E+03	Normal	0.40						
Embodied Energy (MJ)	8.4E+04	Normal	0.41	1.3E+05	Normal	0.40	1.2E+05	Normal	0.40						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		60%	0.50		40%	0.50							

Comments:

None

Date Created:
Approved (YES / NO)?
Official (YES / NO) ?

Not Given
By User
By User

Author:

Not Given

Revisions:

2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.042b

NISTIR Name

Special Concentric Braced Frame w double angle braces, Single Diagonal Brace, Brace 41 PLF < w < 99 PLF

Description

Costing on a per bay basis, equivalent to AISC minimum SCBF criteria. Costing does not include fireproofing removal or reapplication cost.

Line 48

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.

Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.

Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:

Fragility Parameters

Median Demand, θ :

0.00256

0.0048

0.0112

Data dispersion, β_d :

0.28

0.30

0.5

Uncertainty, β_u :

0.1

0.1

0.1

Total Dispersion, β :

0.3

0.3

0.3

Correlation (Yes / No)

NO

Data Quality Marginal

Documentation Quality Marginal

Directionality (Yes / No)

YES

Data Relevance Average

Rationality Average

Consequence Functions

Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Cost by Damage State:	1.43E+04	3.53E+04	3.94E+04	2.26E+04	4.57E+04	5.41E+04	2.54E+04	4.92E+04	5.90E+04						
Best fit mean:	2.96E+04			4.08E+04			4.45E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00			15.00					
Average Repair Cost (Min Qty, Max Qty)	4.24E+04			5.49E+04			5.91E+04			3.94E+04					
CV or beta (Min Qty, Max Qty)	0.33			0.30			0.29			0.29					
Quantity Unit:	Each			Each			Each								
Repair Time:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Time by Damage State:	9.44E+00	2.34E+01	2.60E+01	1.49E+01	3.03E+01	3.58E+01	1.68E+01	3.26E+01	3.90E+01						
Best fit mean:	1.96E+01			2.70E+01			2.95E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00			15.00					
Average Repair Time (Min Qty, Max Qty)	2.80E+01			3.63E+01			3.91E+01			2.61E+01					
CV or beta (Min Qty, Max Qty)	0.41			0.39			0.39			0.39					
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.9E+03	Normal	0.41	1.1E+04	Normal	0.39	1.1E+04	Normal	0.39						
Embodied Energy (MJ)	8.4E+04	Normal	0.41	1.9E+05	Normal	0.39	1.9E+05	Normal	0.39						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		60%	0.50		40%	0.50							

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.042c

NISTIR Name

Special Concentric Braced Frame w double angle braces, Single Diagonal Brace, Brace w > 100 PLF

Description

Costing on a per bay basis, equivalent to AISC minimum SCBF criteria. Costing does not include fireproofing removal or reapplication cost.

Line 49

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.

Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.

Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:

Fragility Parameters

Median Demand, θ :

0.00256

0.0048

0.0112

Data dispersion, β_d :

0.28

0.30

0.5

Uncertainty, β_u :

0.1

0.1

0.1

Total Dispersion, β :

0.3

0.3

0.3

Correlation (Yes / No)

NO

Data Quality Marginal

Documentation Quality Marginal

Directionality (Yes / No)

YES

Data Relevance Average

Rationality Average

Consequence Functions

Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Cost by Damage State:	1.43E+04	3.53E+04	3.94E+04	2.90E+04	5.37E+04	6.52E+04	3.34E+04	5.92E+04	7.29E+04						
Best fit mean:	2.96E+04			4.93E+04			5.52E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00			7.00					
Average Repair Cost (Min Qty, Max Qty)	4.42E+04			6.72E+04			7.40E+04			5.04E+04					
CV or beta (Min Qty, Max Qty)	0.33			0.29			0.28			0.28					
Quantity Unit:	Each			Each			Each								
Repair Time:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Time by Damage State:	9.44E+00	2.34E+01	2.60E+01	1.92E+01	3.56E+01	4.31E+01	2.21E+01	3.92E+01	4.82E+01						
Best fit mean:	1.96E+01			3.26E+01			3.65E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00			7.00					
Average Repair Time (Min Qty, Max Qty)	2.92E+01			4.45E+01			4.90E+01			3.33E+01					
CV or beta (Min Qty, Max Qty)	0.41			0.38			0.37			0.37					
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.9E+03	Normal	0.41	1.3E+04	Normal	0.38	1.3E+04	Normal	0.37						
Embodied Energy (MJ)	8.4E+04	Normal	0.41	2.8E+05	Normal	0.38	2.8E+05	Normal	0.37						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		60%	0.50		40%	0.50							

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.043a

NISTIR Name

Special Concentric Braced Frame w double angle braces, X Brace, Brace w < 40 PLF

Description

Costing on a per bay basis, equivalent to AISC minimum SCBF criteria. Costing does not include fireproofing removal or reapplication cost.

Line 50

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding Round Qty? YES

Allow sum by floor or building? NO

Demand Location (floor above?) No

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.

Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.

Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:

Fragility Parameters

Median Demand, θ :

0.00256

0.0048

0.0112

Data dispersion, β_d :

0.28

0.30

0.5

Uncertainty, β_u :

0.1

0.1

0.1

Total Dispersion, β :

0.3

0.3

0.3

Correlation (Yes / No)

NO

Data Quality Marginal

Documentation Quality Marginal

Directionality (Yes / No)

YES

Data Relevance Average

Rationality Average

Consequence Functions

Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Cost by Damage State:	1.56E+04	3.69E+04	4.17E+04	2.17E+04	4.47E+04	5.27E+04	2.29E+04	4.62E+04	5.48E+04						
Best fit mean:	3.14E+04			3.97E+04			4.13E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00			7.00					
Average Repair Cost (Min Qty, Max Qty)	4.62E+04			5.59E+04			5.78E+04			3.93E+04					
CV or beta (Min Qty, Max Qty)	0.32			0.30			0.30			0.30					
Quantity Unit:	Each			Each			Each								
Repair Time:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Time by Damage State:	1.03E+01	2.44E+01	2.76E+01	1.43E+01	2.96E+01	3.48E+01	1.51E+01	3.06E+01	3.62E+01						
Best fit mean:	2.08E+01			2.63E+01			2.73E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00			7.00					
Average Repair Time (Min Qty, Max Qty)	3.05E+01			3.70E+01			3.82E+01			2.60E+01					
CV or beta (Min Qty, Max Qty)	0.41			0.39			0.39			0.39					
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.9E+03	Normal	0.41	1.0E+04	Normal	0.39	1.0E+04	Normal	0.39						
Embodied Energy (MJ)	8.4E+04	Normal	0.41	1.8E+05	Normal	0.39	1.8E+05	Normal	0.39						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		60%	0.50		40%	0.50							

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.043b

NISTIR Name

Special Concentric Braced Frame w double angle braces, X Brace, Brace 41 PLF < w < 99 PLF

Description

Costing on a per bay basis, equivalent to AISC minimum SCBF criteria. Costing does not include fireproofing removal or reapplication cost.

Line 51

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding Round Qty? YES

Allow sum by floor or building? NO

Demand Location (floor above?) No

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.

Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.

Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:

Fragility Parameters

Median Demand, θ :

0.00256

0.0048

0.0112

Data dispersion, β_d :

0.28

0.30

0.5

Uncertainty, β_u :

0.1

0.1

0.1

Total Dispersion, β :

0.3

0.3

0.3

Correlation (Yes / No)

NO

Data Quality Marginal

Documentation Quality Marginal

Directionality (Yes / No)

YES

Data Relevance Average

Rationality Average

Consequence Functions

Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Cost by Damage State:	1.56E+04	3.69E+04	4.17E+04	3.33E+04	5.92E+04	7.29E+04	3.61E+04	6.27E+04	7.78E+04						
Best fit mean:	3.14E+04			5.51E+04			5.88E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00			7.00					
Average Repair Cost (Min Qty, Max Qty)	4.62E+04			7.40E+04			7.84E+04			5.33E+04					
CV or beta (Min Qty, Max Qty)	0.32			0.28			0.28			0.28					
Quantity Unit:	Each			Each			Each								
Repair Time:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Time by Damage State:	1.03E+01	2.44E+01	2.76E+01	2.20E+01	3.92E+01	4.82E+01	2.39E+01	4.15E+01	5.15E+01						
Best fit mean:	2.08E+01			3.65E+01			3.89E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00			7.00					
Average Repair Time (Min Qty, Max Qty)	3.05E+01			4.90E+01			5.19E+01			3.53E+01					
CV or beta (Min Qty, Max Qty)	0.41			0.38			0.37			0.37					
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.9E+03	Normal	0.41	1.5E+04	Normal	0.38	1.5E+04	Normal	0.37						
Embodied Energy (MJ)	8.4E+04	Normal	0.41	3.3E+05	Normal	0.38	3.3E+05	Normal	0.37						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		60%	0.50		40%	0.50							

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification
NISTIR Name
Description

B1033.043c
Special Concentric Braced Frame w double angle braces, X Brace, Brace w > 100 PLF
Costing on a per bay basis, equivalent to AISC minimum SCBF criteria. Costing does not include fireproofing removal or reapplication cost.

Line 52

Construction Quality:	Not Specified					<div>Quantity RoundingRound Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	EA 1					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	3					
Damage State:	DS1	DS2	DS3			
Type of Damage State:	Sequential	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2,DS3)					
Descriptions	<div>Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.</div> <div>Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.</div> <div>Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.</div>					

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.00256	0.0048	0.0112		
Data dispersion, β_d :	0.28	0.30	0.5		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.3	0.3	0.3		
Correlation (Yes / No)	NO	Data Quality Marginal		Documentation Quality Marginal	
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Average	

Consequence Functions
Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.56E+04	3.69E+04	4.17E+04	4.68E+04	7.60E+04	9.64E+04	5.12E+04	8.15E+04	1.04E+05						
Best fit mean:	3.14E+04			7.30E+04			7.89E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Cost (Min Qty, Max Qty)	4.62E+04			9.50E+04			1.02E+05								
CV or beta (Min Qty, Max Qty)	0.32			0.26			0.26								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.03E+01	2.44E+01	2.76E+01	3.09E+01	5.03E+01	6.38E+01	3.39E+01	5.39E+01	6.89E+01						
Best fit mean:	2.08E+01			4.83E+01			5.22E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Time (Min Qty, Max Qty)	3.05E+01			6.29E+01			6.74E+01								
CV or beta (Min Qty, Max Qty)	0.41			0.36			0.36								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.9E+03	Normal	0.41	2.2E+04	Normal	0.36	2.2E+04	Normal	0.36						
Embodied Energy (MJ)	8.4E+04	Normal	0.41	5.1E+05	Normal	0.36	5.1E+05	Normal	0.36						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		60%	0.50		40%	0.50							

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.051a

NISTIR Name

Ordinary Concentric Braced Frame w compact braces, Chevron Brace, Brace w < 40 PLF

Description

Costing on a per bay basis, braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 53

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual deformation of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.

Brace has buckled but residual displacement does not exceed two times brace depth. Brace has not fractured. Gusset plate exhibits extensive yielding. Yielding extends well into the members.

Brace has fractured. Gusset plate has torn, possibly completely free of framing. Local buckling of flanges and web of framing members. Bolt fractures in beam-column connections.

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:

Fragility Parameters

Median Demand, θ :

0.00159

0.01

0.0178

Data dispersion, β_d :

0.66

0.15

0.43

Uncertainty, β_u :

0.25

0.25

0.25

Total Dispersion, β :

0.7

0.3

0.3

Correlation (Yes / No)

NO

Data Quality Not Rated

Documentation Quality average

Directionality (Yes / No)

YES

Data Relevance Marginal

Rationality Superior

Consequence Functions

Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Replace brace. Gusset plate must be replaced 50% of the time. Heat straightening of deformed beams and columns may be required.

Replace brace. Gusset plate must be replaced 90% of the time. Replacement of portions (deformed flanges, webs) of permanently deformed beams and columns likely required.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Cost by Damage State:	1.45E+04	3.56E+04	3.99E+04	1.80E+04	4.00E+04	4.60E+04	1.94E+04	4.17E+04	4.84E+04						
Best fit mean:	3.00E+04			3.46E+04			3.65E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00			7.00					
Average Repair Cost (Min Qty, Max Qty)	4.45E+04			5.00E+04			5.22E+04			3.55E+04					
CV or beta (Min Qty, Max Qty)	0.33			0.32			0.31			0.31					
Quantity Unit:	Each			Each			Each								
Repair Time:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Time by Damage State:	9.57E+00	2.36E+01	2.64E+01	1.19E+01	2.65E+01	3.04E+01	1.28E+01	2.76E+01	3.20E+01						
Best fit mean:	1.98E+01			2.29E+01			2.41E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00			7.00					
Average Repair Time (Min Qty, Max Qty)	2.95E+01			3.31E+01			3.45E+01			2.35E+01					
CV or beta (Min Qty, Max Qty)	0.41			0.40			0.40			0.40					
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.7E+03	Normal	0.41	8.5E+03	Normal	0.40	8.5E+03	Normal	0.40						
Embodied Energy (MJ)	8.0E+04	Normal	0.41	1.3E+05	Normal	0.40	1.3E+05	Normal	0.40						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		40%	0.50		20%	0.50							

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.051b

NISTIR Name
Description

Ordinary Concentric Braced Frame w compact braces, Chevron Brace, Brace w, 41 PLF < w < 99 PLF
Costing on a per bay basis, braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 54

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual deformation of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.				
	Brace has buckled but residual displacement does not exceed two times brace depth. Brace has not fractured. Gusset plate exhibits extensive yielding. Yielding extends well into the members.				
	Brace has fractured. Gusset plate has torn, possibly completely free of framing. Local buckling of flanges and web of framing members. Bolt fractures in beam-column connections.				

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.00159	0.01	0.0178		
Data dispersion, β_d :	0.66	0.15	0.43		
Uncertainty, β_u :	0.25	0.25	0.25		
Total Dispersion, β :	0.7	0.3	0.3		
Correlation (Yes / No)	NO	Data Quality Not Rated	Documentation Quality average		
Directionality (Yes / No)	YES	Data Relevance Marginal	Rationality Superior		

Consequence Functions
Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.
Replace brace. Gusset plate must be replaced 50% of the time. Heat straightening of deformed beams and columns may be required.
Replace brace. Gusset plate must be replaced 90% of the time. Replacement of portions (deformed flanges, webs) of permanently deformed beams and columns likely required.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.45E+04	3.56E+04	3.99E+04	2.51E+04	4.89E+04	5.85E+04	2.79E+04	5.24E+04	6.34E+04						
Best fit mean:	3.00E+04			4.41E+04			4.79E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Cost (Min Qty, Max Qty)	4.45E+04			6.12E+04			6.55E+04								
CV or beta (Min Qty, Max Qty)	0.33			0.30			0.29								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.57E+00	2.36E+01	2.64E+01	1.66E+01	3.24E+01	3.87E+01	1.84E+01	3.47E+01	4.19E+01						
Best fit mean:	1.98E+01			2.92E+01			3.17E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Time (Min Qty, Max Qty)	2.95E+01			4.05E+01			4.34E+01								
CV or beta (Min Qty, Max Qty)	0.41			0.39			0.38								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.7E+03	Normal	0.41	1.2E+04	Normal	0.39	1.2E+04	Normal	0.38						
Embodied Energy (MJ)	8.0E+04	Normal	0.41	2.3E+05	Normal	0.39	2.3E+05	Normal	0.38						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		40%	0.50		20%	0.50							

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.
Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.051c

NISTIR Name

Ordinary Concentric Braced Frame w compact braces, Chevron Brace, Brace w > 100 PLF

Description

Costing on a per bay basis, braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 55

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual deformation of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.

Brace has buckled but residual displacement does not exceed two times brace depth. Brace has not fractured. Gusset plate exhibits extensive yielding. Yielding extends well into the members.

Brace has fractured. Gusset plate has torn, possibly completely free of framing. Local buckling of flanges and web of framing members. Bolt fractures in beam-column connections.

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:

Fragility Parameters

Median Demand, θ :

0.00159

0.01

0.0178

Data dispersion, β_d :

0.66

0.15

0.43

Uncertainty, β_u :

0.25

0.25

0.25

Total Dispersion, β :

0.7

0.3

0.3

Correlation (Yes / No)

NO

Data Quality Not Rated

Documentation Quality average

Directionality (Yes / No)

YES

Data Relevance Marginal

Rationality Superior

Consequence Functions

Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Replace brace. Gusset plate must be replaced 50% of the time. Heat straightening of deformed beams and columns may be required.

Replace brace. Gusset plate must be replaced 90% of the time. Replacement of portions (deformed flanges, webs) of permanently deformed beams and columns likely required.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Cost by Damage State:	1.45E+04	3.56E+04	3.99E+04	3.40E+04	6.01E+04	7.41E+04	3.80E+04	6.51E+04	8.11E+04						
Best fit mean:	3.00E+04			5.60E+04			6.14E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00			7.00					
Average Repair Cost (Min Qty, Max Qty)	4.45E+04			7.51E+04			8.14E+04			5.53E+04					
CV or beta (Min Qty, Max Qty)	0.33			0.28			0.27								
Quantity Unit:	Each			Each			Each								
Repair Time:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Time by Damage State:	9.57E+00	2.36E+01	2.64E+01	2.25E+01	3.98E+01	4.90E+01	2.51E+01	4.31E+01	5.36E+01						
Best fit mean:	1.98E+01			3.71E+01			4.06E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00			7.00					
Average Repair Time (Min Qty, Max Qty)	2.95E+01			4.97E+01			5.38E+01			3.66E+01					
CV or beta (Min Qty, Max Qty)	0.41			0.37			0.37			0.37					
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.7E+03	Normal	0.41	1.6E+04	Normal	0.37	1.6E+04	Normal	0.37						
Embodied Energy (MJ)	8.0E+04	Normal	0.41	3.4E+05	Normal	0.37	3.4E+05	Normal	0.37						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		40%	0.50		20%	0.50							

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.052a

NISTIR Name
Description

Ordinary Concentric Braced Frame w compact braces, Single Diagonal Brace, Brace w < 40 PLF
Costing on a per bay basis, braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 56

Construction Quality: Not Specified
Seismic Installation Conditions: Not Specified

Fragility Unit of Measure:	EA 1
Demand Parameter (unit):	Story Drift Ratio
Number of Damage States:	3

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual deformation of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Brace has buckled but residual displacement does not exceed two times brace depth. Brace has not fractured. Gusset plate exhibits extensive yielding. Yielding extends well into the members.	Brace has fractured. Gusset plate has torn, possibly completely free of framing. Local buckling of flanges and web of framing members. Bolt fractures in beam-column connections.		

Illustrations

none	none	none			
1.00	1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.00159	0.01	0.0178		
Data dispersion, β_d :	0.66	0.15	0.43		
Uncertainty, β_u :	0.25	0.25	0.25		
Total Dispersion, β :	0.7	0.3	0.3		

Correlation (Yes / No)	NO	Data Quality	Not Rated	Documentation Quality	average
Directionality (Yes / No)	YES	Data Relevance	Marginal	Rationality	Superior

Consequence Functions
Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Replace brace. Gusset plate must be replaced 50% of the time. Heat straightening of deformed beams and columns may be required.

Replace brace. Gusset plate must be replaced 90% of the time. Replacement of portions (deformed flanges, webs) of permanently deformed beams and columns likely required.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.39E+04	3.49E+04	3.88E+04	1.69E+04	3.86E+04	4.41E+04	1.77E+04	3.96E+04	4.55E+04						
Best fit mean:	2.92E+04			3.32E+04			3.43E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Cost (Min Qty, Max Qty)	4.36E+04			4.83E+04			4.95E+04								
CV or beta (Min Qty, Max Qty)	0.33			0.32			0.32								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.17E+00	2.31E+01	2.57E+01	1.12E+01	2.56E+01	2.92E+01	1.17E+01	2.62E+01	3.01E+01						
Best fit mean:	1.93E+01			2.20E+01			2.27E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Time (Min Qty, Max Qty)	2.88E+01			3.20E+01			3.28E+01								
CV or beta (Min Qty, Max Qty)	0.42			0.41			0.40								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.7E+03	Normal	0.42	7.9E+03	Normal	0.41	7.7E+03	Normal	0.40						
Embodied Energy (MJ)	8.0E+04	Normal	0.42	1.2E+05	Normal	0.41	1.1E+05	Normal	0.40						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		40%	0.50		20%	0.50							

Comments:	None	Root Cost Multiplier:	1
Date Created:	Not Given	Date Generated:	02/26/19
Approved (YES / NO)?	By User		
Official (YES / NO) ?	By User		
Author:	Not Given		
Revisions:	2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.		

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.052b

NISTIR Name
Description

Ordinary Concentric Braced Frame w compact braces, Single Diagonal Brace, Brace w, 41 PLF < w < 99 PLF
Costing on a per bay basis, braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 57

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual deformation of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Brace has buckled but residual displacement does not exceed two times brace depth. Brace has not fractured. Gusset plate exhibits extensive yielding. Yielding extends well into the members.	Brace has fractured. Gusset plate has torn, possibly completely free of framing. Local buckling of flanges and web of framing members. Bolt fractures in beam-column connections.		

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, δ :	0.00159	0.01	0.0178		
Data dispersion, β_d :	0.66	0.15	0.43		
Uncertainty, β_u :	0.25	0.25	0.25		
Total Dispersion, β :	0.7	0.3	0.3		
Correlation (Yes / No)	NO	Data Quality Not Rated	Documentation Quality average		
Directionality (Yes / No)	YES	Data Relevance Marginal	Rationality Superior		

Consequence Functions
Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Replace brace. Gusset plate must be replaced 50% of the time. Heat straightening of deformed beams and columns may be required.

Replace brace. Gusset plate must be replaced 90% of the time. Replacement of portions (deformed flanges, webs) of permanently deformed beams and columns likely required.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.39E+04	3.49E+04	3.88E+04	2.12E+04	4.40E+04	5.17E+04	2.40E+04	4.75E+04	5.66E+04						
Best fit mean:	2.92E+04			3.89E+04			4.27E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Cost (Min Qty, Max Qty)	4.36E+04			5.50E+04			5.94E+04								
CV or beta (Min Qty, Max Qty)	0.33			0.31			0.30								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.17E+00	2.31E+01	2.57E+01	1.40E+01	2.91E+01	3.42E+01	1.59E+01	3.14E+01	3.74E+01						
Best fit mean:	1.93E+01			2.58E+01			2.82E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Time (Min Qty, Max Qty)	2.88E+01			3.64E+01			3.93E+01								
CV or beta (Min Qty, Max Qty)	0.42			0.39			0.39								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.7E+03	Normal	0.42	9.9E+03	Normal	0.39	9.9E+03	Normal	0.39						
Embodied Energy (MJ)	8.0E+04	Normal	0.42	1.7E+05	Normal	0.39	1.7E+05	Normal	0.39						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		40%	0.50		20%	0.50							

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.052c

NISTIR Name
Description

Ordinary Concentric Braced Frame w compact braces, Single Diagonal Brace, Brace w > 100 PLF
Costing on a per bay basis, braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 58

Construction Quality:	Not Specified				Quantity Rounding Round Qty? YES Allow sum by floor or building? NO Demand Location (floor above)? No
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	<div>Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual deformation of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.</div> <div>Brace has buckled but residual displacement does not exceed two times brace depth. Brace has not fractured. Gusset plate exhibits extensive yielding. Yielding extends well into the members.</div> <div>Brace has fractured. Gusset plate has torn, possibly completely free of framing. Local buckling of flanges and web of framing members. Bolt fractures in beam-column connections.</div>				

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.00159	0.01	0.0178		
Data dispersion, β_d :	0.66	0.15	0.43		
Uncertainty, β_u :	0.25	0.25	0.25		
Total Dispersion, β :	0.7	0.3	0.3		
Correlation (Yes / No)	NO	Data Quality Not Rated	Documentation Quality average		
Directionality (Yes / No)	YES	Data Relevance Marginal	Rationality Superior		

Consequence Functions
Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Replace brace. Gusset plate must be replaced 50% of the time. Heat straightening of deformed beams and columns may be required.

Replace brace. Gusset plate must be replaced 90% of the time. Replacement of portions (deformed flanges, webs) of permanently deformed beams and columns likely required.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.39E+04	3.49E+04	3.88E+04	2.70E+04	5.12E+04	6.17E+04	3.14E+04	5.67E+04	6.94E+04						
Best fit mean:	2.92E+04			4.66E+04			5.25E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Cost (Min Qty, Max Qty)	4.36E+04			6.40E+04			7.09E+04								
CV or beta (Min Qty, Max Qty)	0.33			0.29			0.28								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.17E+00	2.31E+01	2.57E+01	1.78E+01	3.39E+01	4.08E+01	2.08E+01	3.75E+01	4.59E+01						
Best fit mean:	1.93E+01			3.08E+01			3.47E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Time (Min Qty, Max Qty)	2.88E+01			4.24E+01			4.69E+01								
CV or beta (Min Qty, Max Qty)	0.42			0.38			0.38								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.7E+03	Normal	0.42	1.3E+04	Normal	0.38	1.3E+04	Normal	0.38						
Embodied Energy (MJ)	8.0E+04	Normal	0.42	2.5E+05	Normal	0.38	2.5E+05	Normal	0.38						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		40%	0.50		20%	0.50							

Comments:	None				
Date Created:	Not Given				
Approved (YES / NO)?	By User				
Official (YES / NO) ?	By User				
Author:	Not Given				
Revisions:	2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.				
	Root Cost Multiplier: 1				
	Date Generated: 02/26/19				

FEMA P-58 Fragility Specification

NISTIR Classification B1033.053a
NISTIR Name Ordinary Concentric Braced Frame w compact braces, X Brace, Brace w < 40 PLF
Description Costing on a per bay basis, braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 59

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift RatioUnit less				
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual deformation of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.				
	Brace has buckled but residual displacement does not exceed two times brace depth. Brace has not fractured. Gusset plate exhibits extensive yielding. Yielding extends well into the members.				
	Brace has fractured. Gusset plate has torn, possibly completely free of framing. Local buckling of flanges and web of framing members. Bolt fractures in beam-column connections.				

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.00159	0.01	0.0178		
Data dispersion, β_d :	0.66	0.15	0.43		
Uncertainty, β_u :	0.25	0.25	0.25		
Total Dispersion, β :	0.7	0.3	0.3		
Correlation (Yes / No)	NO	Data Quality Not Rated		Documentation Quality average	
Directionality (Yes / No)	YES	Data Relevance Marginal		Rationality Superior	

Consequence Functions			
Repair Description	Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.	Replace brace. Gusset plate must be replaced 50% of the time. Heat straightening of deformed beams and columns may be required.	Replace brace. Gusset plate must be replaced 90% of the time. Replacement of portions (deformed flanges, webs) of permanently deformed beams and columns likely required.

Long Lead Time (Yes / No)	NO			NO			NO								
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.52E+04	3.65E+04	4.11E+04	2.04E+04	4.30E+04	5.02E+04	2.16E+04	4.45E+04	5.23E+04						
Best fit mean:	3.09E+04			3.78E+04			3.94E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00	7.00		3.00	7.00		3.00	7.00							
Average Repair Cost (Min Qty, Max Qty)	4.56E+04	3.10E+04		5.37E+04	3.65E+04		5.56E+04	3.78E+04							
CV or beta (Min Qty, Max Qty)	0.33	0.33		0.31	0.31		0.30	0.30							
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.00E+01	2.41E+01	2.72E+01	1.35E+01	2.85E+01	3.32E+01	1.43E+01	2.94E+01	3.46E+01						
Best fit mean:	2.04E+01			2.50E+01			2.61E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00	7.00		3.00	7.00		3.00	7.00							
Average Repair Time (Min Qty, Max Qty)	3.02E+01	2.05E+01		3.56E+01	2.42E+01		3.68E+01	2.50E+01							
CV or beta (Min Qty, Max Qty)	0.41	0.41		0.40	0.40		0.39	0.39							
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.7E+03	Normal	0.41	9.5E+03	Normal	0.40	9.5E+03	Normal	0.39						
Embodied Energy (MJ)	8.0E+04	Normal	0.41	1.6E+05	Normal	0.40	1.6E+05	Normal	0.39						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		40%	0.50		20%	0.50							

Comments:	None			Root Cost Multiplier: 1	
Date Created:	Not Given			Date Generated: 02/26/19	
Approved (YES / NO)?	By User				
Official (YES / NO) ?	By User				
Author:	Not Given				
Revisions:	2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.				

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.053b

NISTIR Name

Ordinary Concentric Braced Frame w compact braces, X Brace, Brace w, 41 PLF < w < 99 PLF

Description

Costing on a per bay basis, braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 60

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding Round Qty? YES

Allow sum by floor or building? NO

Demand Location (floor above?) No

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual deformation of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.

Brace has buckled but residual displacement does not exceed two times brace depth. Brace has not fractured. Gusset plate exhibits extensive yielding. Yielding extends well into the members.

Brace has fractured. Gusset plate has torn, possibly completely free of framing. Local buckling of flanges and web of framing members. Bolt fractures in beam-column connections.

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:

Fragility Parameters

Median Demand, θ :

0.00159

0.01

0.0178

Data dispersion, β_d :

0.66

0.15

0.43

Uncertainty, β_u :

0.25

0.25

0.25

Total Dispersion, β :

0.7

0.3

0.3

Correlation (Yes / No)

NO

Data Quality Not Rated

Documentation Quality average

Directionality (Yes / No)

YES

Data Relevance Marginal

Rationality Superior

Consequence Functions

Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Replace brace. Gusset plate must be replaced 50% of the time. Heat straightening of deformed beams and columns may be required.

Replace brace. Gusset plate must be replaced 90% of the time. Replacement of portions (deformed flanges, webs) of permanently deformed beams and columns likely required.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.52E+04	3.65E+04	4.11E+04	3.04E+04	5.55E+04	6.77E+04	3.32E+04	5.90E+04	7.26E+04						
Best fit mean:	3.09E+04			5.12E+04			5.49E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00			7.00					
Average Repair Cost (Min Qty, Max Qty)	4.56E+04			6.93E+04			7.37E+04			5.01E+04					
CV or beta (Min Qty, Max Qty)	0.33			0.28			0.28			0.28					
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.00E+01	2.41E+01	2.72E+01	2.01E+01	3.67E+01	4.48E+01	2.19E+01	3.90E+01	4.80E+01						
Best fit mean:	2.04E+01			3.39E+01			3.63E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00			7.00					
Average Repair Time (Min Qty, Max Qty)	3.02E+01			4.59E+01			4.88E+01			3.32E+01					
CV or beta (Min Qty, Max Qty)	0.41			0.38			0.38			0.38					
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.7E+03	Normal	0.41	1.4E+04	Normal	0.38	1.4E+04	Normal	0.38						
Embodied Energy (MJ)	8.0E+04	Normal	0.41	2.9E+05	Normal	0.38	2.9E+05	Normal	0.38						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00		0%	0.00	
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00		0%	0.00	
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		40%	0.50		20%	0.50							

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.053c

NISTIR Name

Ordinary Concentric Braced Frame w compact braces, X Brace, Brace w > 100 PLF

Description

Costing on a per bay basis, braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 61

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding Round Qty? YES

Allow sum by floor or building? NO

Demand Location (floor above?) No

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual deformation of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.

Brace has buckled but residual displacement does not exceed two times brace depth. Brace has not fractured. Gusset plate exhibits extensive yielding. Yielding extends well into the members.

Brace has fractured. Gusset plate has torn, possibly completely free of framing. Local buckling of flanges and web of framing members. Bolt fractures in beam-column connections.

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:

Fragility Parameters

Median Demand, θ :

0.00159

0.01

0.0178

Data dispersion, β_d :

0.66

0.15

0.43

Uncertainty, β_u :

0.25

0.25

0.25

Total Dispersion, β :

0.7

0.3

0.3

Correlation (Yes / No)

NO

Data Quality Not Rated

Documentation Quality average

Directionality (Yes / No)

YES

Data Relevance Marginal

Rationality Superior

Consequence Functions

Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Replace brace. Gusset plate must be replaced 50% of the time. Heat straightening of deformed beams and columns may be required.

Replace brace. Gusset plate must be replaced 90% of the time. Replacement of portions (deformed flanges, webs) of permanently deformed beams and columns likely required.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.52E+04	3.65E+04	4.11E+04	4.25E+04	7.07E+04	8.90E+04	4.69E+04	7.62E+04	9.67E+04						
Best fit mean:	3.09E+04			6.74E+04			7.32E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00			7.00					
Average Repair Cost (Min Qty, Max Qty)	4.56E+04			8.83E+04			9.52E+04			6.47E+04					
CV or beta (Min Qty, Max Qty)	0.33			0.27			0.27			0.27					
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.00E+01	2.41E+01	2.72E+01	2.81E+01	4.68E+01	5.89E+01	3.10E+01	5.04E+01	6.40E+01						
Best fit mean:	2.04E+01			4.46E+01			4.85E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00			7.00					
Average Repair Time (Min Qty, Max Qty)	3.02E+01			5.85E+01			6.30E+01			4.28E+01					
CV or beta (Min Qty, Max Qty)	0.41			0.37			0.36			0.36					
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.7E+03	Normal	0.41	2.0E+04	Normal	0.37	2.0E+04	Normal	0.36						
Embodied Energy (MJ)	8.0E+04	Normal	0.41	4.6E+05	Normal	0.37	4.6E+05	Normal	0.36						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		40%	0.50		20%	0.50							

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.061a

NISTIR Name
Description

Ordinary Concentric Braced Frame, braces design to ductile slenderness limits, Chevron Brace, Brace w < 40 PLF
Costing on a per bay basis, equivalent to AISC OCBF criteria. Braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 62

Construction Quality:		Not Specified		<div>Quantity Rounding</div> <div>Round Qty?</div> <div>YES</div> <div>Allow sum by floor or building?</div> <div>NO</div> <div>Demand Location (floor above?)</div> <div>No</div>	
Seismic Installation Conditions:		Not Specified			
Fragility Unit of Measure:		EA 1			
Demand Parameter (unit):		Story Drift Ratio			
Number of Damage States:		3		Unit less	
Damage State:		DS1		DS2	
Type of Damage State:		Sequential		DS3	
DS Hierarchy		Seq(DS1,DS2,DS3)		Sequential	
Descriptions		Buckling of brace in excess of the brace		Buckling of brace or gusset. Buckling of	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	0.00159	0.01	0.01776	
Data dispersion, β_d :	0.65	0.15	0.4	
Uncertainty, β_u :	0.25	0.25	0.25	
Total Dispersion, β :	0.7	0.3	0.3	

Correlation (Yes / No)	NO	Data Quality Average	Documentation Quality Average
Directionality (Yes / No)	YES	Data Relevance Average	Rationality Average

Consequence Functions
Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.49E+04	3.61E+04	4.05E+04	1.84E+04	4.05E+04	4.66E+04	1.98E+04	4.22E+04	4.90E+04						
Best fit mean:	3.05E+04			3.51E+04			3.70E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Cost (Min Qty, Max Qty)	4.51E+04			5.06E+04			5.27E+04								
CV or beta (Min Qty, Max Qty)	0.33			0.31			0.31								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.83E+00	2.39E+01	2.68E+01	1.22E+01	2.68E+01	3.08E+01	1.31E+01	2.79E+01	3.24E+01						
Best fit mean:	2.02E+01			2.32E+01			2.45E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Time (Min Qty, Max Qty)	2.98E+01			3.35E+01			3.49E+01								
CV or beta (Min Qty, Max Qty)	0.41			0.40			0.40								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.9E+03	Normal	0.41	8.7E+03	Normal	0.40	8.7E+03	Normal	0.40						
Embodied Energy (MJ)	8.4E+04	Normal	0.41	1.4E+05	Normal	0.40	1.4E+05	Normal	0.40						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable								
Casualty-affected Planar Area (sf) per Normative Unit:	0%			0%			0%								
Serious Injury (Median, Dispersion)	0%			0%			0%								
Loss of Life (Median, Dispersion)	0%			0%			0%								
Post-event Tagging Flag:	YES			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	60%			40%			20%								

Comments:	None	Root Cost Multiplier:	1
Date Created:	Not Given	Date Generated:	02/26/19
Approved (YES / NO)?	By User		
Official (YES / NO) ?	By User		
Author:	Not Given		
Revisions:	2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.		

FEMA P-58 Fragility Specification

NISTIR Classification
NISTIR Name
Description

B1033.061b
Ordinary Concentric Braced Frame, braces design to ductile slenderness limits, Chevron Brace, Brace 41 PLF < w < 99 PLF
Costing on a per bay basis, equivalent to AISC OCBF criteria. Braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 63

Construction Quality:	Not Specified							
Seismic Installation Conditions:	Not Specified							
Fragility Unit of Measure:	EA 1		Quantity Rounding Round Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No					
Demand Parameter (unit):	Story Drift Ratio Unit less							
Number of Damage States:	3							
Damage State:	DS1	DS2	DS3					
Type of Damage State:	Sequential	Sequential	Sequential					
DS Hierarchy	Seq(DS1,DS2,DS3)							
Descriptions	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 time brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas. Nearly total loss of lateral resistance.					
Illustrations								
Damage State Probability:	none 1.00	none 1.00	none 1.00					
Fragility Parameters								
Median Demand, θ :	0.00159	0.01	0.01776					
Data dispersion, β_d :	0.65	0.15	0.4					
Uncertainty, β_u :	0.25	0.25	0.25					
Total Dispersion, β :	0.7	0.3	0.3					
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Average				
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Average				
Consequence Functions								
Repair Description	Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.	Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.	Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed					

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.49E+04	3.61E+04	4.05E+04	2.58E+04	4.98E+04	5.98E+04	2.86E+04	5.33E+04	6.47E+04						
Best fit mean:	3.05E+04			4.51E+04			4.88E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Cost (Min Qty, Max Qty)	4.51E+04			6.23E+04			6.67E+04								
CV or beta (Min Qty, Max Qty)	0.33			0.29			0.29								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.83E+00	2.39E+01	2.68E+01	1.70E+01	3.30E+01	3.95E+01	1.89E+01	3.53E+01	4.28E+01						
Best fit mean:	2.02E+01			2.99E+01			3.23E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Time (Min Qty, Max Qty)	2.98E+01			4.12E+01			4.41E+01								
CV or beta (Min Qty, Max Qty)	0.41			0.39			0.38								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.9E+03	Normal	0.41	1.2E+04	Normal	0.39	1.2E+04	Normal	0.38						
Embodied Energy (MJ)	8.4E+04	Normal	0.41	2.3E+05	Normal	0.39	2.3E+05	Normal	0.38						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	YES			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	60%	0.50		40%	0.50		20%	0.50							

Comments:
Date Created:
Approved (YES / NO)?
Official (YES / NO) ?
Author:
Revisions:

None
Not Given
By User
By User
Not Given
2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.061c

NISTIR Name
Description

Ordinary Concentric Braced Frame, braces design to ductile slenderness limits, Chevron Brace, Brace w > 100 PLF
Costing on a per bay basis, equivalent to AISC OCBF criteria. Braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 64

Construction Quality:	Not Specified							
Seismic Installation Conditions:	Not Specified							
Fragility Unit of Measure:	EA 1		Quantity Rounding Round Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No					
Demand Parameter (unit):	Story Drift Ratio Unit less							
Number of Damage States:	3							
Damage State:	DS1	DS2	DS3					
Type of Damage State:	Sequential	Sequential	Sequential					
DS Hierarchy	Seq(DS1,DS2,DS3)							
Descriptions	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 time brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas. Nearly total loss of lateral resistance.					
Illustrations								
Damage State Probability:	1.00	1.00	1.00					
Fragility Parameters								
Median Demand, θ :	0.00159	0.01	0.01776					
Data dispersion, β_d :	0.65	0.15	0.4					
Uncertainty, β_u :	0.25	0.25	0.25					
Total Dispersion, β :	0.7	0.3	0.3					
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Average				
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Average				
Consequence Functions								
Repair Description	Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.	Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.	Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed					

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.49E+04	3.61E+04	4.05E+04	3.47E+04	6.10E+04	7.54E+04	3.87E+04	6.60E+04	8.24E+04						
Best fit mean:	3.05E+04			5.70E+04			6.23E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Cost (Min Qty, Max Qty)	4.51E+04			7.62E+04			8.25E+04								
CV or beta (Min Qty, Max Qty)	0.33			0.28			0.27								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.83E+00	2.39E+01	2.68E+01	2.29E+01	4.04E+01	4.99E+01	2.56E+01	4.37E+01	5.45E+01						
Best fit mean:	2.02E+01			3.77E+01			4.13E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Time (Min Qty, Max Qty)	2.98E+01			5.04E+01			5.46E+01								
CV or beta (Min Qty, Max Qty)	0.41			0.37			0.37								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.9E+03	Normal	0.41	1.6E+04	Normal	0.37	1.6E+04	Normal	0.37						
Embodied Energy (MJ)	8.4E+04	Normal	0.41	3.5E+05	Normal	0.37	3.5E+05	Normal	0.37						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	YES			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	60%	0.50		40%	0.50		20%	0.50							

Comments:

None

Date Created:
Approved (YES / NO)?

Not Given
By User

Root Cost Multiplier: 1
Date Generated: 02/26/19

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

FEMA P-58 Fragility Specification

NISTIR Classification
NISTIR Name
Description

B1033.062a
Ordinary Concentric Braced Frame, braces design to ductile slenderness limits, Single Diagonal Brace, Brace w < 40 PLF
Costing on a per bay basis, equivalent to AISC OCBF criteria. Braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 65

Construction Quality:		Not Specified		<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>	
Seismic Installation Conditions:		Not Specified			
Fragility Unit of Measure:		EA 1			
Demand Parameter (unit):		Story Drift RatioUnit less			
Number of Damage States:		3			
Damage State:		DS1	DS2	DS3	
Type of Damage State:		Sequential	Sequential	Sequential	
DS Hierarchy		Seq(DS1,DS2,DS3)			
Descriptions		Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 time brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas. Nearly total loss of lateral resistance.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?	NO	
Demand Location (floor above?)	NO	

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	0.00159	0.01	0.01776	
Data dispersion, β_d :	0.65	0.15	0.4	
Uncertainty, β_u :	0.25	0.25	0.25	
Total Dispersion, β :	0.7	0.3	0.3	
Correlation (Yes / No)	NO	Data Quality Average	Documentation Quality Average	
Directionality (Yes / No)	YES	Data Relevance Average	Rationality Average	

Consequence Functions
Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.43E+04	3.53E+04	3.94E+04	1.73E+04	3.91E+04	4.47E+04	1.79E+04	3.99E+04	4.59E+04						
Best fit mean:	2.96E+04			3.37E+04			3.46E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Cost (Min Qty, Max Qty)	4.42E+04			4.89E+04			4.99E+04								
CV or beta (Min Qty, Max Qty)	0.33			0.32			0.32								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.44E+00	2.34E+01	2.60E+01	1.14E+01	2.59E+01	2.96E+01	1.18E+01	2.64E+01	3.03E+01						
Best fit mean:	1.96E+01			2.23E+01			2.29E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Time (Min Qty, Max Qty)	2.92E+01			3.23E+01			3.30E+01								
CV or beta (Min Qty, Max Qty)	0.41			0.40			0.40								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.9E+03	Normal	0.41	8.1E+03	Normal	0.40	7.8E+03	Normal	0.40						
Embodied Energy (MJ)	8.4E+04	Normal	0.41	1.2E+05	Normal	0.40	1.1E+05	Normal	0.40						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable								
Casualty-affected Planar Area (sf) per Normative Unit:	0%			0%			0%								
Serious Injury (Median, Dispersion)	0%			0%			0%								
Loss of Life (Median, Dispersion)	0%			0%			0%								
Post-event Tagging Flag:	YES			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	60%			40%			20%								

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification
NISTIR Name
Description

B1033.062b
Ordinary Concentric Braced Frame, braces design to ductile slenderness limits, Single Diagonal Brace, Brace 41 PLF < w < 99 PLF
Costing on a per bay basis, equivalent to AISC OCBF criteria. Braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 66

Construction Quality:	Not Specified							
Seismic Installation Conditions:	Not Specified							
Fragility Unit of Measure:	EA 1		<div>Quantity RoundingRound Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No</div>					
Demand Parameter (unit):	Story Drift RatioUnit less							
Number of Damage States:	3							
Damage State:	DS1	DS2	DS3					
Type of Damage State:	Sequential	Sequential	Sequential					
DS Hierarchy	Seq(DS1,DS2,DS3)							
Descriptions	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 time brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas. Nearly total loss of lateral resistance.					
Illustrations								
Damage State Probability:	none 1.00	none 1.00	none 1.00					
Fragility Parameters								
Median Demand, θ :	0.00159	0.01	0.01776					
Data dispersion, β_d :	0.65	0.15	0.4					
Uncertainty, β_u :	0.25	0.25	0.25					
Total Dispersion, β :	0.7	0.3	0.3					
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Average				
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Average				
Consequence Functions								
Repair Description	Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.	Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.	Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed					

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.43E+04	3.53E+04	3.94E+04	2.17E+04	4.46E+04	5.25E+04	2.45E+04	4.81E+04	5.74E+04						
Best fit mean:	2.96E+04			3.96E+04			4.33E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Cost (Min Qty, Max Qty)	4.42E+04			5.58E+04			6.01E+04								
CV or beta (Min Qty, Max Qty)	0.33			0.30			0.30								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.44E+00	2.34E+01	2.60E+01	1.43E+01	2.95E+01	3.47E+01	1.62E+01	3.18E+01	3.80E+01						
Best fit mean:	1.96E+01			2.62E+01			2.87E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Time (Min Qty, Max Qty)	2.92E+01			3.69E+01			3.98E+01								
CV or beta (Min Qty, Max Qty)	0.41			0.39			0.39								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.9E+03	Normal	0.41	1.0E+04	Normal	0.39	1.0E+04	Normal	0.39						
Embodied Energy (MJ)	8.4E+04	Normal	0.41	1.8E+05	Normal	0.39	1.8E+05	Normal	0.39						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%			0%			0%								
Loss of Life (Median, Dispersion)	0%			0%			0%								
Post-event Tagging Flag:	YES			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	60%			40%			20%								

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification
NISTIR Name
Description

B1033.062c
Ordinary Concentric Braced Frame, braces design to ductile slenderness limits, Single Diagonal Brace, Brace w > 100 PLF
Costing on a per bay basis, equivalent to AISC OCBF criteria. Braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 67

Construction Quality:		Not Specified		<div>Quantity RoundingRound Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No</div>	
Seismic Installation Conditions:		Not Specified			
Fragility Unit of Measure:		EA 1			
Demand Parameter (unit):		Story Drift Ratio			
Number of Damage States:		3		Unit less	
Damage State:		DS1		DS2	
Type of Damage State:		Sequential		DS3	
DS Hierarchy		Seq(DS1,DS2,DS3)		Sequential	
Descriptions		Buckling of brace in excess of the brace		Buckling of brace or gusset. Buckling of	

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	0.00159	0.01	0.01776	
Data dispersion, β_d :	0.65	0.15	0.4	
Uncertainty, β_u :	0.25	0.25	0.25	
Total Dispersion, β :	0.7	0.3	0.3	
Correlation (Yes / No)	NO	Data Quality Average	Documentation Quality Average	
Directionality (Yes / No)	YES	Data Relevance Average	Rationality Average	

Consequence Functions
Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.43E+04	3.53E+04	3.94E+04	2.75E+04	5.18E+04	6.25E+04	3.19E+04	5.73E+04	7.02E+04						
Best fit mean:	2.96E+04			4.72E+04			5.31E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Cost (Min Qty, Max Qty)	4.42E+04			6.48E+04			7.16E+04								
CV or beta (Min Qty, Max Qty)	0.33			0.29			0.28								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.44E+00	2.34E+01	2.60E+01	1.82E+01	3.43E+01	4.13E+01	2.11E+01	3.79E+01	4.64E+01						
Best fit mean:	1.96E+01			3.13E+01			3.51E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Time (Min Qty, Max Qty)	2.92E+01			4.29E+01			4.74E+01								
CV or beta (Min Qty, Max Qty)	0.41			0.38			0.38								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.9E+03	Normal	0.41	1.3E+04	Normal	0.38	1.3E+04	Normal	0.38						
Embodied Energy (MJ)	8.4E+04	Normal	0.41	2.6E+05	Normal	0.38	2.6E+05	Normal	0.38						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable								
Casualty-affected Planar Area (sf) per Normative Unit:	0%			0%			0%								
Serious Injury (Median, Dispersion)	0%			0%			0%								
Loss of Life (Median, Dispersion)	0%			0%			0%								
Post-event Tagging Flag:	YES			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	60%			40%			20%								

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.063a

NISTIR Name

Ordinary Concentric Braced Frame, braces design to ductile slenderness limits, X Brace, Brace w < 40 PLF

Description

Costing on a per bay basis, equivalent to AISC OCBF criteria. Braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 68

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding Round Qty? YES

Allow sum by floor or building? NO

Demand Location (floor above?) No

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.

Buckling of brace in excess of 2 time brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.

Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas. Nearly total loss of lateral resistance.

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:

Fragility Parameters

Median Demand, θ :

0.00159

0.01

0.01776

Data dispersion, β_d :

0.65

0.15

0.4

Uncertainty, β_u :

0.25

0.25

0.25

Total Dispersion, β :

0.7

0.3

0.3

Correlation (Yes / No)

NO

Data Quality Average

Documentation Quality Average

Directionality (Yes / No)

YES

Data Relevance Average

Rationality Average

Consequence Functions

Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Cost by Damage State:	1.56E+04	3.69E+04	4.17E+04	2.10E+04	4.37E+04	5.13E+04	2.22E+04	4.52E+04	5.34E+04						
Best fit mean:	3.14E+04			3.87E+04			4.03E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00			7.00					
Average Repair Cost (Min Qty, Max Qty)	4.62E+04			5.47E+04			5.66E+04			3.85E+04					
CV or beta (Min Qty, Max Qty)	0.32			0.31			0.30			0.30					
Quantity Unit:	Each			Each			Each								
Repair Time:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Time by Damage State:	1.03E+01	2.44E+01	2.76E+01	1.39E+01	2.89E+01	3.39E+01	1.47E+01	2.99E+01	3.53E+01						
Best fit mean:	2.08E+01			2.56E+01			2.66E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00			7.00					
Average Repair Time (Min Qty, Max Qty)	3.05E+01			3.62E+01			3.74E+01			2.54E+01					
CV or beta (Min Qty, Max Qty)	0.41			0.40			0.39			0.39					
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.9E+03	Normal	0.41	9.8E+03	Normal	0.40	9.8E+03	Normal	0.39						
Embodied Energy (MJ)	8.4E+04	Normal	0.41	1.7E+05	Normal	0.40	1.7E+05	Normal	0.39						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	YES			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	60%	0.50		40%	0.50		20%	0.50							

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification
NISTIR Name
Description

B1033.063b
Ordinary Concentric Braced Frame, braces design to ductile slenderness limits, X Brace, Brace 41 PLF < w < 99 PLF
Costing on a per bay basis, equivalent to AISC OCBF criteria. Braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 69

Construction Quality:	Not Specified							
Seismic Installation Conditions:	Not Specified							
Fragility Unit of Measure:	EA 1		Quantity RoundingRound Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No					
Demand Parameter (unit):	Story Drift RatioUnit less							
Number of Damage States:	3							
Damage State:	DS1	DS2	DS3					
Type of Damage State:	Sequential	Sequential	Sequential					
DS Hierarchy	Seq(DS1,DS2,DS3)							
Descriptions	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 time brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas. Nearly total loss of lateral resistance.					
Illustrations								
Damage State Probability:	none 1.00	none 1.00	none 1.00					
Fragility Parameters								
Median Demand, θ :	0.00159	0.01	0.01776					
Data dispersion, β_d :	0.65	0.15	0.4					
Uncertainty, β_u :	0.25	0.25	0.25					
Total Dispersion, β :	0.7	0.3	0.3					
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Average				
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Average				
Consequence Functions								
Repair Description	Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.	Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.	Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed					

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.56E+04	3.69E+04	4.17E+04	3.16E+04	5.70E+04	6.98E+04	3.44E+04	6.05E+04	7.47E+04						
Best fit mean:	3.14E+04			5.28E+04			5.65E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Cost (Min Qty, Max Qty)	4.62E+04			7.12E+04			7.56E+04								
CV or beta (Min Qty, Max Qty)	0.32			0.28			0.28								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.03E+01	2.44E+01	2.76E+01	2.09E+01	3.77E+01	4.62E+01	2.27E+01	4.00E+01	4.94E+01						
Best fit mean:	2.08E+01			3.49E+01			3.74E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Time (Min Qty, Max Qty)	3.05E+01			4.71E+01			5.00E+01								
CV or beta (Min Qty, Max Qty)	0.41			0.38			0.37								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.9E+03	Normal	0.41	1.5E+04	Normal	0.38	1.5E+04	Normal	0.37						
Embodied Energy (MJ)	8.4E+04	Normal	0.41	3.1E+05	Normal	0.38	3.1E+05	Normal	0.37						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	YES			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	60%	0.50		40%	0.50		20%	0.50							

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.063c

NISTIR Name

Ordinary Concentric Braced Frame, braces design to ductile slenderness limits, X Brace, Brace w > 100 PLF

Description

Costing on a per bay basis, equivalent to AISC OCBF criteria. Braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 70

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding Round Qty? YES

Allow sum by floor or building? NO

Demand Location (floor above?) No

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.

Buckling of brace in excess of 2 time brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.

Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas. Nearly total loss of lateral resistance.

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:

Fragility Parameters

Median Demand, θ :

0.00159

0.01

0.01776

Data dispersion, β_d :

0.65

0.15

0.4

Uncertainty, β_u :

0.25

0.25

0.25

Total Dispersion, β :

0.7

0.3

0.3

Correlation (Yes / No)

NO

Data Quality Average

Documentation Quality Average

Directionality (Yes / No)

YES

Data Relevance Average

Rationality Average

Consequence Functions

Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Cost by Damage State:	1.56E+04	3.69E+04	4.17E+04	4.37E+04	7.22E+04	9.11E+04	4.81E+04	7.77E+04	9.88E+04						
Best fit mean:	3.14E+04			6.90E+04			7.48E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00			7.00					
Average Repair Cost (Min Qty, Max Qty)	4.62E+04			9.02E+04			9.71E+04			6.60E+04					
CV or beta (Min Qty, Max Qty)	0.32			0.27			0.26			0.26					
Quantity Unit:	Each			Each			Each								
Repair Time:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Time by Damage State:	1.03E+01	2.44E+01	2.76E+01	2.89E+01	4.78E+01	6.03E+01	3.18E+01	5.14E+01	6.54E+01						
Best fit mean:	2.08E+01			4.56E+01			4.95E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00			7.00					
Average Repair Time (Min Qty, Max Qty)	3.05E+01			5.97E+01			6.42E+01			4.37E+01					
CV or beta (Min Qty, Max Qty)	0.41			0.37			0.36			0.36					
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.9E+03	Normal	0.41	2.0E+04	Normal	0.37	2.0E+04	Normal	0.36						
Embodied Energy (MJ)	8.4E+04	Normal	0.41	4.7E+05	Normal	0.37	4.7E+05	Normal	0.36						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	YES			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	60%	0.50		40%	0.50		20%	0.50							

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1033.071a

Braced frame, design for factored loads, no additional seismic detailing, Chevron Brace, Brace w < 40 PLF

Costing on a per bay basis, equivalent to current AISC R=3. Braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 71

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

EA 1

Story Drift Ratio

1

DS1

Sequential

Seq(DS1)

Fracture of brace or gusset. Buckling of gusset. Substantial loss of lateral resistance.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.0042

Not Specified

0.25

0.25

NO

YES

Data Quality

Not Rated

Documentation Quality

Average

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.84E+04

4.05E+04

4.66E+04

3.51E+04

Normal

3.00

7.00

5.06E+04

3.44E+04

0.31

0.31

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.22E+01

2.68E+01

3.08E+01

2.32E+01

Normal

3.00

7.00

3.35E+01

2.28E+01

0.40

0.40

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

8.7E+03

Normal

0.40

1.4E+05

Normal

0.40

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

YES

20%

0.50

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

currently shown in DS3... Please confirm if two additional damage state performances should be added or if only one cost damage state should be included.

Not Given

By User

By User

Not Given

2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1033.071b

Braced frame, design for factored loads, no additional seismic detailing, Chevron Brace, 41 PLF < w < 99 PLF

Costing on a per bay basis, equivalent to current AISC R=3. Braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 72

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

EA 1

Story Drift Ratio

1

DS1

Sequential

Seq(DS1)

Fracture of brace or gusset. Buckling of gusset. Substantial loss of lateral resistance.

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.0042

Not Specified

0.25

0.25

NO

YES

Data Quality

Not Rated

Documentation Quality

Average

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

2.58E+04

4.98E+04

5.98E+04

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

4.51E+04

Normal

3.00

7.00

6.23E+04

4.24E+04

0.29

0.29

Each

P₁₀

P₅₀

P₉₀

1.70E+01

3.30E+01

3.95E+01

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.99E+01

Normal

3.00

7.00

4.12E+01

2.80E+01

0.39

0.39

Each

Median Cost

Best Fit

CV or Beta

1.2E+04

Normal

0.39

Median Cost

Best Fit

CV or Beta

2.3E+05

Normal

0.39

NO

Not Applicable

0%

0.00

0%

0.00

YES

20%

0.50

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

currently shown in DS3... Please confirm if two additional damage state performances should be added or if only one cost damage state should be included.

Not Given

By User

By User

Not Given

2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1033.071c

Braced frame, design for factored loads, no additional seismic detailing, Chevron Brace, Brace w > 100 PLF

Costing on a per bay basis, equivalent to current AISC R=3. Braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 73

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

EA 1

Story Drift Ratio

1

DS1

Sequential

Seq(DS1)

Fracture of brace or gusset. Buckling of gusset. Substantial loss of lateral resistance.

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.0042

Not Specified

0.25

0.25

NO

YES

Data Quality

Not Rated

Documentation Quality

Average

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Time:

Environmental Impacts:

LifeSafety Hazard:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

3.47E+04

6.10E+04

7.54E+04

5.70E+04

Normal

3.00

7.00

7.62E+04

5.18E+04

0.28

0.28

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

2.29E+01

4.04E+01

4.99E+01

3.77E+01

Normal

3.00

7.00

5.04E+01

3.43E+01

0.37

0.37

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO₂eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

1.6E+04

Normal

0.37

3.5E+05

Normal

0.37

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

YES

20%

0.50

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

currently shown in DS3... Please confirm if two additional damage state performances should be added or if only one cost damage state should be included.

Not Given

By User

By User

Not Given

2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.072a

Line 74

NISTIR Name
Description

Braced frame, design for factored loads, no additional seismic detailing, Single Diagonal Brace, Brace w < 40 PLF
Costing on a per bay basis, equivalent to current AISC R=3. Braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Construction Quality: Not Specified
Seismic Installation Conditions: Not Specified

Fragility Unit of Measure:	EA 1
Demand Parameter (unit):	Story Drift Ratio Unit less
Number of Damage States:	1

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Damage State:	DS1				
Type of Damage State:	Sequential				
DS Hierarchy	Seq(DS1)				
Descriptions	Fracture of brace or gusset. Buckling of gusset. Substantial loss of lateral resistance.				

Illustrations

none					
1.00					

Damage State Probability:

Fragility Parameters					
Median Demand, θ :	0.0042				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	0.25				
Total Dispersion, β :	0.25				

Correlation (Yes / No) NO Data Quality Not Rated Documentation Quality Average
Directionality (Yes / No) YES Data Relevance Average Rationality Superior

Consequence Functions

Repair Description

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Long Lead Time (Yes / No)

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.73E+04	3.91E+04	4.47E+04												
Best fit mean:	3.37E+04														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00												
Average Repair Cost (Min Qty, Max Qty)	4.89E+04		3.32E+04												
CV or beta (Min Qty, Max Qty)	0.32		0.32												
Quantity Unit:	Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.14E+01	2.59E+01	2.96E+01												
Best fit mean:	2.23E+01														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00												
Average Repair Time (Min Qty, Max Qty)	3.23E+01		2.20E+01												
CV or beta (Min Qty, Max Qty)	0.40		0.40												
Quantity Unit:	Each														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	8.1E+03	Normal	0.40												
Embodied Energy (MJ)	1.2E+05	Normal	0.40												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	YES														
Unsafe Placard Trigger (Median, Dispersion)	20%	0.50													

Comments:

Date Created:
Approved (YES / NO)?
Official (YES / NO) ?
Author:
Revisions:

currently shown in DS3... Please confirm if two additional damage state performances should be added or if only one cost damage state should be included.
Not Given
By User
By User
Not Given
2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.
Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1033.072b

Braced frame, design for factored loads, no additional seismic detailing, Single Diagonal Brace, 41 PLF < w < 99 PLF

Costing on a per bay basis, equivalent to current AISC R=3. Braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 75

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

EA 1

Story Drift Ratio

1

DS1

Sequential

Seq(DS1)

Fracture of brace or gusset. Buckling of gusset. Substantial loss of lateral resistance.

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.0042

Not Specified

0.25

0.25

NO

YES

Data Quality

Not Rated

Documentation Quality

Average

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

2.17E+04

4.46E+04

5.25E+04

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

3.96E+04

Normal

3.00

7.00

5.58E+04

3.79E+04

0.30

0.30

Each

P₁₀

P₅₀

P₉₀

1.43E+01

2.95E+01

3.47E+01

2.62E+01

Normal

3.00

7.00

3.69E+01

2.51E+01

0.39

0.39

Each

Median Cost

Best Fit

CV or Beta

1.0E+04

Normal

0.39

1.8E+05

Normal

0.39

NO

Not Applicable

0%

0.00

0%

0.00

YES

20%

0.50

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

currently shown in DS3... Please confirm if two additional damage state performances should be added or if only one cost damage state should be included.

Not Given

By User

By User

Not Given

2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1033.072c

Braced frame, design for factored loads, no additional seismic detailing, Single Diagonal Brace, Brace w > 100 PLF

Costing on a per bay basis, equivalent to current AISC R=3. Braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 76

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

EA 1

Story Drift Ratio

1

DS1

Sequential

Seq(DS1)

Fracture of brace or gusset. Buckling of gusset. Substantial loss of lateral resistance.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.0042

Not Specified

0.25

0.25

NO

YES

Data Quality

Not Rated

Documentation Quality

Average

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

2.75E+04

5.18E+04

6.25E+04

4.72E+04

Normal

3.00

7.00

6.48E+04

4.40E+04

0.29

0.29

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.82E+01

3.43E+01

4.13E+01

3.13E+01

Normal

3.00

7.00

4.29E+01

2.91E+01

0.38

0.38

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO₂eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

1.3E+04

Normal

0.38

2.6E+05

Normal

0.38

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

YES

20%

0.50

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

currently shown in DS3... Please confirm if two additional damage state performances should be added or if only one cost damage state should be included.

Not Given

By User

By User

Not Given

2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1033.073a

Braced frame, design for factored loads, no additional seismic detailing, X Brace, Brace w < 40 PLF

Costing on a per bay basis, equivalent to current AISC R=3. Braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 77

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

EA 1

Story Drift Ratio

1

DS1

Sequential

Seq(DS1)

Fracture of brace or gusset. Buckling of gusset. Substantial loss of lateral resistance.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

none

1.00

Damage State Probability:

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

0.0042

Not Specified

0.25

0.25

Correlation (Yes / No)

NO

Data Quality

Not Rated

Documentation Quality

Average

Directionality (Yes / No)

YES

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

2.10E+04

4.37E+04

5.13E+04

3.87E+04

Normal

3.00

7.00

5.47E+04

3.72E+04

0.31

0.31

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.39E+01

2.89E+01

3.39E+01

2.56E+01

Normal

3.00

7.00

3.62E+01

2.46E+01

0.40

0.40

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

9.8E+03

Normal

0.40

1.7E+05

Normal

0.40

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

YES

20%

0.50

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

currently shown in DS3... Please confirm if two additional damage state performances should be added or if only one cost damage state should be included.

Not Given

By User

By User

Not Given

2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1033.073b

Braced frame, design for factored loads, no additional seismic detailing, X Brace, Brace 41 PLF < w < 99 PLF

Costing on a per bay basis, equivalent to current AISC R=3. Braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 78

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

EA 1

Story Drift Ratio

1

DS1

Sequential

Seq(DS1)

Fracture of brace or gusset. Buckling of gusset. Substantial loss of lateral resistance.

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.0042

Not Specified

0.25

0.25

NO

YES

Data Quality

Not Rated

Documentation Quality

Average

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

3.16E+04

5.70E+04

6.98E+04

5.28E+04

Normal

3.00

7.00

7.12E+04

4.84E+04

0.28

0.28

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

2.09E+01

3.77E+01

4.62E+01

3.49E+01

Normal

3.00

7.00

4.71E+01

3.20E+01

0.38

0.38

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO₂eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

1.5E+04

Normal

0.38

3.1E+05

Normal

0.38

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

YES

20%

0.50

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

currently shown in DS3... Please confirm if two additional damage state performances should be added or if only one cost damage state should be included.

Not Given

By User

By User

Not Given

2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1033.073c

Braced frame, design for factored loads, no additional seismic detailing, X Brace, Brace w > 100 PLF

Costing on a per bay basis, equivalent to current AISC R=3. Braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 79

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

EA 1

Story Drift Ratio

1

DS1

Sequential

Seq(DS1)

Fracture of brace or gusset. Buckling of gusset. Substantial loss of lateral resistance.

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.0042

Not Specified

0.25

0.25

NO

YES

Data Quality

Not Rated

Documentation Quality

Average

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Time:

Environmental Impacts:

LifeSafety Hazard:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

4.37E+04

7.22E+04

9.11E+04

6.90E+04

Normal

3.00

7.00

9.02E+04

6.13E+04

0.27

0.27

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

2.89E+01

4.78E+01

6.03E+01

4.56E+01

Normal

3.00

7.00

5.97E+01

4.06E+01

0.37

0.37

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

2.0E+04

Normal

0.37

4.7E+05

Normal

0.37

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

YES

20%

0.50

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

currently shown in DS3... Please confirm if two additional damage state performances should be added or if only one cost damage state should be included.

Not Given

By User

By User

Not Given

2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1033.101a

Steel Buckling Restrained Brace (BRB), Chevron Brace, Weight of brace < 40 plf.

None

Line 80

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

EA 1

Story Drift Ratio

1

DS1

Sequential

Seq(DS1)

Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas. Severe loss of lateral resistance.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.02

Not Specified

Not Specified

0.4

NO

YES

Data Quality

Not Rated

Data Relevance

Not Rated

Documentation Quality

Not Rated

Rationality

Not Rated

Consequence Functions

Repair Description

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

2.14E+04

4.43E+04

5.21E+04

3.92E+04

Normal

5.00

20.00

5.76E+04

3.54E+04

0.31

0.31

Each

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.41E+01

2.93E+01

3.45E+01

2.60E+01

Normal

5.00

20.00

3.81E+01

2.35E+01

0.39

0.39

Each

Environmental Impacts:

Embodied Carbon (kg CO₂eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

1.0E+04

Normal

0.39

1.8E+05

Normal

0.39

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

John Wallace

2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight. Median demand established from PEER TBI project.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification B1033.101b
NISTIR Name Steel Buckling Restrained Brace (BRB), Chevron brace, Weight of brace > 41 plf and < 99 plf.
Description None

Line 81

Construction Quality:	Not Specified				Quantity Rounding		Round Qty?	YES
Seismic Installation Conditions:	Not Specified				Allow sum by floor or building?		NO	
Fragility Unit of Measure:	EA 1				Demand Location (floor above?)		No	
Demand Parameter (unit):	Story Drift Ratio		Unit less					
Number of Damage States:	1							
Damage State:	DS1							
Type of Damage State:	Sequential							
DS Hierarchy	Seq(DS1)							
Descriptions	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas. Severe loss of lateral resistance.							

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Illustrations					
	none				
	1.00				

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.02				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	Not Specified				
Total Dispersion, β :	0.4				
Correlation (Yes / No)	NO	Data Quality	Not Rated	Documentation Quality	Not Rated
Directionality (Yes / No)	YES	Data Relevance	Not Rated	Rationality	Not Rated

Consequence Functions
Repair Description
Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.24E+04	5.81E+04	7.13E+04												
Best fit mean:	5.39E+04														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00												
Average Repair Cost (Min Qty, Max Qty)	7.55E+04		4.65E+04												
CV or beta (Min Qty, Max Qty)	0.28		0.28												
Quantity Unit:	Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.14E+01	3.84E+01	4.72E+01												
Best fit mean:	3.57E+01														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00												
Average Repair Time (Min Qty, Max Qty)	5.00E+01		3.07E+01												
CV or beta (Min Qty, Max Qty)	0.38		0.38												
Quantity Unit:	Each														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.5E+04	Normal	0.38												
Embodied Energy (MJ)	3.2E+05	Normal	0.38												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: John Wallace
Revisions: 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight. Median demand established from PEER TBI project.
Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1033.101c

Steel Buckling Restrained Brace (BRB), Chevron Brace, Weight of brace > 100 plf.

None

Line 82

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

EA 1

Story Drift Ratio

1

DS1

Sequential

Seq(DS1)

Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas. Severe loss of lateral resistance.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.02

Not Specified

Not Specified

0.4

NO

YES

Data Quality

Not Rated

Data Relevance

Not Rated

Documentation Quality

Not Rated

Rationality

Not Rated

Consequence Functions

Repair Description

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

4.62E+04

7.52E+04

9.53E+04

7.22E+04

Normal

5.00

20.00

9.78E+04

6.02E+04

0.27

0.27

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

3.05E+01

4.98E+01

6.30E+01

4.78E+01

Normal

5.00

20.00

6.47E+01

3.98E+01

0.36

0.36

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

2.1E+04

Normal

0.36

5.1E+05

Normal

0.36

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

John Wallace

2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight. Median demand established from PEER TBI project.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification B1033.111a
NISTIR Name Steel Buckling Restrained Brace (BRB), Single Diagonal Brace, Weight of brace < 40 plf.
Description None

Line 83

Construction Quality:	Not Specified				
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio Unit less				
Number of Damage States:	1				
Damage State:	DS1				
Type of Damage State:	Sequential				
DS Hierarchy	Seq(DS1)				
Descriptions	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas. Severe loss of lateral resistance.				

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Illustrations					
	none				
	1.00				

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.02				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	Not Specified				
Total Dispersion, β :	0.4				
Correlation (Yes / No)	NO		Data Quality	Not Rated	
Directionality (Yes / No)	YES		Data Relevance	Not Rated	
			Documentation Quality	Not Rated	
			Rationality	Not Rated	

Consequence Functions
Repair Description
Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.92E+04	4.15E+04	4.82E+04												
Best fit mean:	3.63E+04														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00														
Average Repair Cost (Min Qty, Max Qty)	5.40E+04 3.32E+04														
CV or beta (Min Qty, Max Qty)	0.31 0.31														
Quantity Unit:	Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.27E+01	2.75E+01	3.19E+01												
Best fit mean:	2.40E+01														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00														
Average Repair Time (Min Qty, Max Qty)	3.57E+01 2.20E+01														
CV or beta (Min Qty, Max Qty)	0.40 0.40														
Quantity Unit:	Each														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	8.8E+03	Normal	0.40												
Embodied Energy (MJ)	1.4E+05	Normal	0.40												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0% 0.00														
Loss of Life (Median, Dispersion)	0% 0.00														
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00														

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: John Wallace
Revisions: 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight. Median demand established from PEER TBI project.
Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1033.111b
Steel Buckling Restrained Brace (BRB), Single Diagonal brace, Weight of brace > 41 plf and < 99 plf.
None

Line 84

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified
Not Specified
EA 1
Story Drift Ratio
1
DS1
Sequential
Seq(DS1)
Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas. Severe loss of lateral resistance.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

none				
1.00				

Fragility Parameters					
Median Demand, θ :	0.02				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	Not Specified				
Total Dispersion, β :	0.4				
Correlation (Yes / No)	NO	Data Quality	Not Rated	Documentation Quality	Not Rated
Directionality (Yes / No)	YES	Data Relevance	Not Rated	Rationality	Not Rated

Consequence Functions

Repair Description

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Long Lead Time (Yes / No)

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.66E+04	5.07E+04	6.10E+04												
Best fit mean:	4.61E+04														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00												
Average Repair Cost (Min Qty, Max Qty)	6.59E+04		4.06E+04												
CV or beta (Min Qty, Max Qty)	0.29		0.29												
Quantity Unit:	Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.76E+01	3.36E+01	4.03E+01												
Best fit mean:	3.05E+01														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00												
Average Repair Time (Min Qty, Max Qty)	4.36E+01		2.68E+01												
CV or beta (Min Qty, Max Qty)	0.38		0.38												
Quantity Unit:	Each														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.2E+04	Normal	0.38												
Embodied Energy (MJ)	2.4E+05	Normal	0.38												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

John Wallace

2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight. Median demand established from PEER TBI project.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification B1033.111c
NISTIR Name Steel Buckling Restrained Brace (BRB), Single Diagonal Brace, Weight of brace > 100 plf.
Description None

Line 85

Construction Quality:	Not Specified			Quantity Rounding		Round Qty?	YES
Seismic Installation Conditions:	Not Specified			Allow sum by floor or building? NO			
Fragility Unit of Measure:	EA 1			Demand Location (floor above?) No			
Demand Parameter (unit):	Story Drift Ratio			Unit less			
Number of Damage States:	1						
Damage State:	DS1						
Type of Damage State:	Sequential						
DS Hierarchy	Seq(DS1)						
Descriptions	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas. Severe loss of lateral resistance.						

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

none				
1.00				

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.02				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	Not Specified				
Total Dispersion, β :	0.4				
Correlation (Yes / No)	NO	Data Quality	Not Rated	Documentation Quality	Not Rated
Directionality (Yes / No)	YES	Data Relevance	Not Rated	Rationality	Not Rated

Consequence Functions
Repair Description

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.54E+04	6.18E+04	7.66E+04												
Best fit mean:	5.79E+04														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00												
Average Repair Cost (Min Qty, Max Qty)	8.04E+04		4.95E+04												
CV or beta (Min Qty, Max Qty)	0.28		0.28												
Quantity Unit:	Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.34E+01	4.09E+01	5.07E+01												
Best fit mean:	3.83E+01														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00												
Average Repair Time (Min Qty, Max Qty)	5.32E+01		3.27E+01												
CV or beta (Min Qty, Max Qty)	0.37		0.37												
Quantity Unit:	Each														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.6E+04	Normal	0.37												
Embodied Energy (MJ)	3.6E+05	Normal	0.37												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%		0.00												
Loss of Life (Median, Dispersion)	0%		0.00												
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00												

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: John Wallace
Revisions: 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight. Median demand established from PEER TBI project.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1035.001

Post-Northridge RBS connection with welded web, beam one side of column only, beam depth <= W27

Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 86

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

EA 1

Story Drift Ratio

3

DS1

Sequential

Seq(DS1,DS2,DS3)

Local beam flange and web buckling.

Not Specified

DS2

Sequential

DS1 plus lateral-torsional distortion of beam in hinge region.

Not Specified

DS3

Sequential

Low-cycle fatigue fracture in buckled region of RBS.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

none

1.00

none

1.00

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.03

Not Specified

0.3

0.3

NO

YES

Data Quality

Data Relevance

Superior

Average

Documentation Quality

Rationality

Superior

Superior

Consequence Functions

Repair Description

The likely repair state is heat straightening of the buckled flanges and web. Repair and replace partitions at connection.

Repair will necessitate removal and replacement of distorted and/or fractured portion of beam. Repair and replace partitions at connection.

Repair will necessitate removal and replacement of distorted and/or fractured portion of beam. Repair and replace partitions at connection.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

8.10E+03

1.74E+04

2.26E+04

Normal

3.00

7.00

2.18E+04

0.35

Each

P₁₀

P₅₀

P₉₀

1.41E+04

2.93E+04

3.44E+04

Normal

3.00

7.00

3.66E+04

0.31

Each

P₁₀

P₅₀

P₉₀

1.41E+04

2.93E+04

3.44E+04

Normal

3.00

7.00

3.66E+04

0.31

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

4.76E+00

1.02E+01

1.33E+01

Normal

3.00

7.00

1.28E+01

0.43

Each

P₁₀

P₅₀

P₉₀

8.29E+00

1.72E+01

2.02E+01

Normal

3.00

7.00

2.15E+01

0.39

Each

P₁₀

P₅₀

P₉₀

8.29E+00

1.72E+01

2.02E+01

Normal

3.00

7.00

2.15E+01

0.39

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

3.0E+03

Normal

0.43

Median Cost

Best Fit

CV or Beta

8.0E+03

Normal

0.39

Median Cost

Best Fit

CV or Beta

8.0E+03

Normal

0.39

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

YES

50%

0.50

NO

Not Applicable

0%

0.00

YES

50%

0.50

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Greg Deierlein

None

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1035.002

Post-Northridge RBS connection with welded web, beam one side of column only, beam depth >= W30

Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 87

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

EA 1

Story Drift Ratio

3

DS1

Sequential

Seq(DS1,DS2,DS3)

Local beam flange and web buckling.

Not Specified

DS2

Sequential

DS1 plus lateral-torsional distortion of beam in hinge region.

Not Specified

DS3

Sequential

Low-cycle fatigue fracture in buckled region of RBS.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.00

0.03

Not Specified

0.3

0.3

NO

YES

Data Quality

Superior

Data Relevance

Average

Documentation Quality

Superior

Rationality

Superior

Consequence Functions

Repair Description

The likely repair state is heat straightening of the buckled flanges and web. Repair and replace partitions at connection.

Repair will necessitate removal and replacement of distorted and/or fractured portion of beam. Repair and replace partitions at connection.

Repair will necessitate removal and replacement of distorted and/or fractured portion of beam. Repair and replace partitions at connection.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Time:

Environmental Impacts:

LifeSafety Hazard:

P₁₀

P₅₀

P₉₀

9.10E+03

1.84E+04

2.36E+04

P₁₀

P₅₀

P₉₀

1.61E+04

3.24E+04

3.68E+04

P₁₀

P₅₀

P₉₀

1.61E+04

3.24E+04

3.68E+04

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

1.70E+04

Normal

3.00

7.00

0.33

Each

P₁₀

P₅₀

P₉₀

1.61E+04

3.24E+04

3.68E+04

P₁₀

P₅₀

P₉₀

1.61E+04

3.24E+04

3.68E+04

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

1.08E+01

Normal

3.00

7.00

0.42

Each

P₁₀

P₅₀

P₉₀

9.47E+00

1.91E+01

2.16E+01

P₁₀

P₅₀

P₉₀

9.47E+00

1.91E+01

2.16E+01

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Median Cost

Best Fit

CV or Beta

3.0E+03

Normal

0.42

Median Cost

Best Fit

CV or Beta

8.8E+03

Normal

0.38

Median Cost

Best Fit

CV or Beta

8.8E+03

Normal

0.38

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

P₁₀

P₅₀

P₉₀

5.35E+00

1.08E+01

1.39E+01

P₁₀

P₅₀

P₉₀

9.47E+00

1.91E+01

2.16E+01

P₁₀

P₅₀

P₉₀

9.47E+00

1.91E+01

2.16E+01

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Median Cost

Best Fit

CV or Beta

3.0E+03

Normal

0.42

Median Cost

Best Fit

CV or Beta

8.8E+03

Normal

0.38

Median Cost

Best Fit

CV or Beta

8.8E+03

Normal

0.38

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

NO

0%

0.00

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

YES

50%

0.50

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

YES

50%

0.50

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Greg Deierlein

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1035.011

Post-Northridge RBS connection with welded web, beams both sides of column, beam depth <= W27

Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 88

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

EA 1

Story Drift Ratio

3

DS1

Sequential

Seq(DS1,DS2,DS3)

Local beam flange and web buckling.

Not Specified

DS2

Sequential

DS1 plus lateral-torsional distortion of beam in hinge region.

Not Specified

DS3

Sequential

Low-cycle fatigue fracture in buckled region of RBS.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

none

1.00

none

1.00

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.03

Not Specified

0.3

0.3

NO

YES

Data Quality

Data Relevance

Superior

Average

Documentation Quality

Rationality

Superior

Superior

Consequence Functions

Repair Description

The likely repair state is heat straightening of the buckled flanges and web. Repair and replace partitions at connection.

Repair will necessitate removal and replacement of distorted and/or fractured portion of beam. Repair and replace partitions at connection.

Repair will necessitate removal and replacement of distorted and/or fractured portion of beam. Repair and replace partitions at connection.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Time:

Environmental Impacts:

LifeSafety Hazard:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.37E+04

3.00E+04

3.60E+04

Normal

3.00

7.00

3.75E+04

2.55E+04

0.33

0.33

Each

P₁₀

P₅₀

P₉₀

2.77E+04

5.23E+04

6.10E+04

Normal

3.00

7.00

6.54E+04

4.45E+04

0.28

0.28

Each

P₁₀

P₅₀

P₉₀

2.77E+04

5.23E+04

6.10E+04

Normal

3.00

7.00

6.54E+04

4.45E+04

0.28

0.28

Each

P₁₀

P₅₀

P₉₀

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

8.06E+00

1.76E+01

2.12E+01

Normal

3.00

7.00

2.21E+01

1.50E+01

0.41

0.41

Each

P₁₀

P₅₀

P₉₀

1.63E+01

3.08E+01

3.59E+01

Normal

3.00

7.00

3.85E+01

2.61E+01

0.37

0.37

Each

P₁₀

P₅₀

P₉₀

1.63E+01

3.08E+01

3.59E+01

Normal

3.00

7.00

3.85E+01

2.61E+01

0.37

0.37

Each

P₁₀

P₅₀

P₉₀

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

5.7E+03

Normal

0.41

1.6E+04

Normal

0.37

1.6E+04

Normal

0.37

6.1E+04

Normal

0.41

2.5E+05

Normal

0.37

2.5E+05

Normal

0.37

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

NO

YES

0%

0.00

NO

YES

0%

0.50

NO

Not Applicable

0%

0.00

NO

YES

50%

0.50

NO

YES

50%

0.50

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Greg Deierlein

None

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1035.012

Post-Northridge RBS connection with welded web, beams both sides of column, beam depth >= W30

Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 89

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

EA 1

Story Drift Ratio

3

DS1

Sequential

Seq(DS1,DS2,DS3)

Local beam flange and web buckling.

Not Specified

DS2

Sequential

DS1 plus lateral-torsional distortion of beam in hinge region.

Not Specified

DS3

Sequential

Low-cycle fatigue fracture in buckled region of RBS.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

none

1.00

none

1.00

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.03

Not Specified

0.3

0.3

NO

YES

Data Quality

Data Relevance

Superior

Average

Documentation Quality

Rationality

Superior

Superior

Consequence Functions

Repair Description

The likely repair state is heat straightening of the buckled flanges and web. Repair and replace partitions at connection.

Repair will necessitate removal and replacement of distorted and/or fractured portion of beam. Repair and replace partitions at connection.

Repair will necessitate removal and replacement of distorted and/or fractured portion of beam. Repair and replace partitions at connection.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.57E+04

3.20E+04

3.85E+04

P₁₀

P₅₀

P₉₀

3.27E+04

5.85E+04

6.60E+04

P₁₀

P₅₀

P₉₀

3.27E+04

5.85E+04

6.60E+04

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.87E+04

Normal

7.00

3.00

7.00

4.00E+04

2.72E+04

7.31E+04

4.97E+04

7.31E+04

4.97E+04

0.31

0.31

0.25

0.25

0.25

0.25

Each

Each

Each

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

9.24E+00

1.88E+01

2.26E+01

P₁₀

P₅₀

P₉₀

1.92E+01

3.44E+01

3.88E+01

P₁₀

P₅₀

P₉₀

1.92E+01

3.44E+01

3.88E+01

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.88E+01

Normal

7.00

3.00

7.00

2.35E+01

1.60E+01

4.30E+01

2.93E+01

4.30E+01

2.93E+01

0.40

0.40

0.35

0.35

0.35

0.35

Each

Each

Each

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

5.7E+03

Normal

0.40

Median Cost

Best Fit

CV or Beta

1.8E+04

Normal

0.35

Median Cost

Best Fit

CV or Beta

1.8E+04

Normal

0.35

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

3.0E+05

Normal

0.35

3.0E+05

Normal

0.35

3.0E+05

Normal

0.35

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

NO

Not Applicable

0%

0.00

NO

Not Applicable

0%

0.00

NO

YES

50%

0.50

NO

YES

50%

0.50

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Greg Deierlein

None

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1035.021

Post-Northridge welded steel moment connection other than RBS, beam one side, beam depth <= W27

Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 90

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

EA 1

Story Drift Ratio

3

DS1

Sequential

Seq(DS1,DS2,DS3)

Local beam flange and web buckling.

Not Specified

DS2

Sequential

DS1 plus lateral-torsional distortion of beam in hinge region.

DS3

Sequential

Low-cycle fatigue fracture in buckled region of RBS.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

none

1.00

none

1.00

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.03

Not Specified

0.3

0.3

NO

YES

Data Quality

Data Relevance

Superior

Average

Documentation Quality

Rationality

Superior

Superior

Consequence Functions

Repair Description

The likely repair state is heat straightening of the buckled flanges and web. Repair and replace partitions at connection.

Repair will necessitate removal and replacement of distorted and/or fractured portion of beam. Repair and replace partitions at connection.

Repair will necessitate removal and replacement of distorted and/or fractured portion of beam. Repair and replace partitions at connection.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Time:

Environmental Impacts:

LifeSafety Hazard:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

8.10E+03

1.74E+04

2.26E+04

Normal

3.00

7.00

2.09E+04

1.39E+04

0.35

0.35

Each

P₁₀

P₅₀

P₉₀

1.41E+04

2.93E+04

3.44E+04

Normal

3.00

7.00

3.52E+04

2.34E+04

0.31

0.31

Each

P₁₀

P₅₀

P₉₀

1.41E+04

2.93E+04

3.44E+04

Normal

3.00

7.00

3.52E+04

2.34E+04

0.31

0.31

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

4.76E+00

1.02E+01

1.33E+01

Normal

3.00

7.00

1.23E+01

8.19E+00

0.43

0.43

Each

P₁₀

P₅₀

P₉₀

8.29E+00

1.72E+01

2.02E+01

Normal

3.00

7.00

2.07E+01

1.38E+01

0.39

0.39

Each

P₁₀

P₅₀

P₉₀

8.29E+00

1.72E+01

2.02E+01

Normal

3.00

7.00

2.07E+01

1.38E+01

0.39

0.39

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

3.0E+03

Normal

0.43

8.0E+03

Normal

0.39

8.0E+03

Normal

0.39

3.3E+04

Normal

0.43

1.3E+05

Normal

0.39

1.3E+05

Normal

0.39

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

YES

0%

0.00

50%

0.50

50%

0.50

NO

Not Applicable

0%

0.00

0%

0.00

NO

YES

0%

0.00

50%

0.50

50%

0.50

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Greg Deierlein

None

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1035.022

Post-Northridge welded steel moment connection other than RBS, beam one side, beam depth >= W30

Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 91

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

EA 1

Story Drift Ratio

3

DS1

Sequential

Seq(DS1,DS2,DS3)

Local beam flange and web buckling.

Not Specified

DS2

Sequential

DS1 plus lateral-torsional distortion of beam in hinge region.

Not Specified

DS3

Sequential

Low-cycle fatigue fracture in buckled region of RBS.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.00

0.03

Not Specified

0.3

0.3

NO

YES

Data Quality

Superior

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

The likely repair state is heat straightening of the buckled flanges and web. Repair and replace partitions at connection.

Repair will necessitate removal and replacement of distorted and/or fractured portion of beam. Repair and replace partitions at connection.

Repair will necessitate removal and replacement of distorted and/or fractured portion of beam. Repair and replace partitions at connection.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Time:

Environmental Impacts:

LifeSafety Hazard:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

9.10E+03

1.84E+04

2.36E+04

1.61E+04

3.24E+04

3.68E+04

1.61E+04

3.24E+04

3.68E+04

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

5.35E+00

1.08E+01

1.39E+01

9.47E+00

1.91E+01

2.16E+01

9.47E+00

1.91E+01

2.16E+01

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

3.0E+03

Normal

0.42

8.8E+03

Normal

0.38

8.8E+03

Normal

0.38

1.5E+05

Normal

0.38

1.5E+05

Normal

0.38

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

YES

0%

0.00

50%

0.50

50%

0.50

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Greg Deierlein

None

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1035.031

Post-Northridge welded steel moment connection other than RBS, beams both sides, beam depth <= W27

Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 92

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

EA 1

Story Drift Ratio

3

DS1

Sequential

Seq(DS1,DS2,DS3)

Local beam flange and web buckling.

Not Specified

DS2

Sequential

DS1 plus lateral-torsional distortion of beam in hinge region.

Not Specified

DS3

Sequential

Low-cycle fatigue fracture in buckled region of RBS.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

none

1.00

none

1.00

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.03

Not Specified

0.3

0.3

NO

YES

Data Quality

Superior

Data Relevance

Average

Documentation Quality

Superior

Rationality

Superior

Consequence Functions

Repair Description

The likely repair state is heat straightening of the buckled flanges and web. Repair and replace partitions at connection.

Repair will necessitate removal and replacement of distorted and/or fractured portion of beam. Repair and replace partitions at connection.

Repair will necessitate removal and replacement of distorted and/or fractured portion of beam. Repair and replace partitions at connection.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

1.47E+04

3.50E+04

4.15E+04

P₁₀

P₅₀

P₉₀

2.77E+04

5.23E+04

6.10E+04

P₁₀

P₅₀

P₉₀

2.77E+04

5.23E+04

6.10E+04

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

3.04E+04

Normal

3.00

7.00

4.70E+04

Normal

3.00

7.00

4.70E+04

Normal

3.00

7.00

2.80E+04

0.34

0.34

6.28E+04

0.28

0.28

4.18E+04

0.28

0.28

6.28E+04

0.28

0.28

Each

Each

Each

P₁₀

P₅₀

P₉₀

8.65E+00

2.06E+01

2.44E+01

P₁₀

P₅₀

P₉₀

1.63E+01

3.08E+01

3.59E+01

P₁₀

P₅₀

P₉₀

1.63E+01

3.08E+01

3.59E+01

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.06E+01

Normal

3.00

7.00

3.08E+01

Normal

3.00

7.00

3.08E+01

Normal

3.00

7.00

1.65E+01

0.43

0.43

3.69E+01

0.37

0.37

2.46E+01

0.37

0.37

3.69E+01

0.37

0.37

Each

Each

Each

Median Cost

Best Fit

CV or Beta

5.7E+03

Normal

0.43

Median Cost

Best Fit

CV or Beta

1.6E+04

Normal

0.37

Median Cost

Best Fit

CV or Beta

1.6E+04

Normal

0.37

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

6.1E+04

Normal

0.43

2.5E+05

Normal

0.37

2.5E+05

Normal

0.37

2.5E+05

Normal

0.37

NO

Not Applicable

NO

Not Applicable

NO

Not Applicable

0%

0.00

0%

0.00

0%

0.00

0%

0.00

0%

0.00

0%

0.00

NO

YES

YES

YES

0%

0.00

50%

0.50

50%

0.50

50%

0.50

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Greg Deierlein

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1035.032

Post-Northridge welded steel moment connection other than RBS, beams both sides, beam depth >= W30

Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 93

Construction Quality:	Not Specified				
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio				
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Local beam flange and web buckling.	DS1 plus lateral-torsional distortion of beam in hinge region.	Low-cycle fatigue fracture in buckled region of RBS.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.03	0.04	0.05		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	0.3	0.3	0.3		
Total Dispersion, β :	0.3	0.3	0.3		
Correlation (Yes / No)	NO	Data Quality Superior	Documentation Quality Superior		
Directionality (Yes / No)	YES	Data Relevance Average	Rationality Superior		

Consequence Functions
Repair Description

The likely repair state is heat straightening of the buckled flanges and web. Repair and replace partitions at connection.

Repair will necessitate removal and replacement of distorted and/or fractured portion of beam. Repair and replace partitions at connection.

Repair will necessitate removal and replacement of distorted and/or fractured portion of beam. Repair and replace partitions at connection.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.47E+04	3.50E+04	4.15E+04	3.27E+04	5.85E+04	6.60E+04	3.27E+04	5.85E+04	6.60E+04						
Best fit mean:	3.04E+04			5.24E+04			5.24E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Cost (Min Qty, Max Qty)	4.20E+04			7.02E+04			7.02E+04								
CV or beta (Min Qty, Max Qty)	0.34			0.25			0.25								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.65E+00	2.06E+01	2.44E+01	1.92E+01	3.44E+01	3.88E+01	1.92E+01	3.44E+01	3.88E+01						
Best fit mean:	2.06E+01			3.44E+01			3.44E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Time (Min Qty, Max Qty)	2.47E+01			4.13E+01			4.13E+01								
CV or beta (Min Qty, Max Qty)	0.43			0.35			0.35								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	5.7E+03	Normal	0.43	1.8E+04	Normal	0.35	1.8E+04	Normal	0.35						
Embodied Energy (MJ)	6.1E+04	Normal	0.43	3.0E+05	Normal	0.35	3.0E+05	Normal	0.35						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		50%	0.50		50%	0.50							

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Greg Deierlein

None

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1035.041

NISTIR Name

Pre-Northridge WUF-B beam-column joint, beam one side of column, beam depth <= W27

Description

Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 94

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?	NO	
Demand Location (floor above?)	NO	

Number of Damage States:

5

Damage State:

DS1

DS2

DS3

DS4

DS5

Type of Damage State:

Mutually Exclusive

Mutually Exclusive

Mutually Exclusive

Mutually Exclusive

Sequential

DS Hierarchy

Seq(MutEx(DS1,DS2),MutEx(DS3,DS4),DS5)

Descriptions

Fracture of lower beam flange weld and failure of web bolts (shear tab connection), with fractures confined to the weld region.

Fracture of upper beam flange weld, without DS1 type damage. Fracture is confined to beam flange region.

Similar to DS3, except that fracture propagates into column flanges.

Fracture initiating at weld access hole and propagating through beam flange, possibly accompanied by local buckling deformations of web and flange.

Illustrations

				
B1035.041-DS1-1.JPG	B1035.041-DS2-1.JPG	none	none	none

Damage State Probability:

0.75

0.25

0.75

0.25

1.00

Fragility Parameters

Median Demand, θ :

0.017

0.017

0.025

0.025

0.03

Data dispersion, β_d :

Not Specified

Not Specified

Not Specified

Not Specified

Not Specified

Uncertainty, β_u :

0.4

0.4

0.4

0.4

0.4

Total Dispersion, β :

0.4

0.4

0.4

0.4

0.4

Correlation (Yes / No)

NO

Data Quality Average

Documentation Quality Superior

Directionality (Yes / No)

YES

Data Relevance Average

Rationality Superior

Consequence Functions

Repair Description

Repair will typically require gouging out and re-welding of the beam flange weld, repair of shear tab, and replacing shear bolts. Repair and replace partitions at connection.

In addition to column measures for DS1, repairs to column will be necessary. Cover plate, patch, or replace damaged column flange at connection.

Repairs will be similar to those required for DS1, except that access to weld will likely require removal and replacement of a portion of the floor slab above the weld.

In addition to column measures for DS3, repairs to column will be necessary that will involve replacing a portion of the column flange.

Repair is similar to that for DS1 except that a portion of the beam web and flange may need to be heat straightened or replaced.

Long Lead Time (Yes / No)

NO

NO

NO

NO

NO

Repair Costs:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Cost by Damage State:	6.54E+03	1.21E+04	1.73E+04	7.54E+03	1.36E+04	1.98E+04	1.10E+04	1.71E+04	2.53E+04	1.11E+04	1.76E+04	2.84E+04	9.04E+03	1.46E+04	2.18E+04
Best fit mean:	1.20E+04 Normal			1.36E+04 Normal			1.69E+04 LogNormal			1.77E+04 LogNormal			1.43E+04 LogNormal		
Best Fit Distribution:	Normal			Normal			LogNormal			LogNormal			LogNormal		
Quantity Plateau (Min Qty, Max Qty)	5.00 30.00			5.00 30.00			5.00 30.00			5.00 30.00			5.00 30.00		
Average Repair Cost (Min Qty, Max Qty)	1.45E+04 9.65E+03			1.63E+04 1.08E+04			1.75E+04 1.16E+04			2.11E+04 1.41E+04			1.75E+04 1.16E+04		
CV or beta (Min Qty, Max Qty)	0.35 0.35			0.35 0.35			0.32 0.32			0.37 0.37			0.34 0.34		
Quantity Unit:	Each			Each			Each			Each			Each		
Repair Time:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Time by Damage State:	3.85E+00	7.09E+00	1.02E+01	4.44E+00	7.98E+00	1.17E+01	6.49E+00	1.00E+01	1.49E+01	6.52E+00	1.04E+01	1.67E+01	5.32E+00	8.56E+00	1.28E+01
Best fit mean:	7.09E+00 Normal			7.98E+00 Normal			1.00E+01 LogNormal			1.04E+01 LogNormal			8.56E+00 LogNormal		
Best Fit Distribution:	Normal			Normal			LogNormal			LogNormal			LogNormal		
Quantity Plateau (Min Qty, Max Qty)	5.00 30.00			5.00 30.00			5.00 30.00			5.00 30.00			5.00 30.00		
Average Repair Time (Min Qty, Max Qty)	8.51E+00 5.68E+00			9.57E+00 6.38E+00			1.17E+01 8.32E+00			1.24E+01 8.28E+00			1.03E+01 6.85E+00		
CV or beta (Min Qty, Max Qty)	0.43 0.43			0.43 0.43			0.41 0.41			0.45 0.45			0.42 0.42		
Quantity Unit:	Each			Each			Each			Each			Each		
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.4E+03	Normal	0.43	2.7E+03	Normal	0.43	5.8E+03	LogNormal	0.41	5.5E+03	LogNormal	0.45	1.4E+03	LogNormal	0.42
Embodied Energy (MJ)	2.0E+04	Normal	0.43	3.6E+04	Normal	0.43	8.1E+04	LogNormal	0.41	7.5E+04	LogNormal	0.45	2.0E+04	LogNormal	0.42
LifeSafety Hazard:	NO			NO			NO			NO			NO		
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO			NO		
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable			Not Applicable		
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00			0% 0.00		
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00			0% 0.00		
Post-event Tagging Flag:	YES			YES			YES			YES			YES		
Unsafe Placard Trigger (Median, Dispersion)	50% 0.50			50% 0.50			50% 0.50			50% 0.50			50% 0.50		

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Greg Deierlein

Revisions:

None

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1035.042

NISTIR Name

Pre-Northridge WUF-B beam-column joint, beam one side of column, beam depth >= W30

Description

Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 95

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?	NO	
Demand Location (floor above?)	NO	

Number of Damage States:

5

Damage State:

DS1

DS2

DS3

DS4

DS5

Type of Damage State:

Mutually Exclusive

Mutually Exclusive

Mutually Exclusive

Mutually Exclusive

Sequential

DS Hierarchy

Seq(MutEx(DS1,DS2),MutEx(DS3,DS4),DS5)

Descriptions

Fracture of lower beam flange weld and failure of web bolts (shear tab connection), with fractures confined to the weld region.

Similar to DS1, except that fracture propagates into column flanges.

Fracture of upper beam flange weld, without DS1 type damage. Fracture is confined to beam flange region.

Similar to DS3, except that fracture propagates into column flanges.

Fracture initiating at weld access hole and propagating through beam flange, possibly accompanied by local buckling deformations of web and flange.

Illustrations

				
B1035.041-DS1-1.JPG	B1035.041-DS2-1.JPG	none	none	none
0.75	0.25	0.75	0.25	1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

0.017

0.017

0.025

0.025

0.03

Data dispersion, β_d :

Not Specified

Not Specified

Not Specified

Not Specified

Not Specified

Uncertainty, β_u :

0.4

0.4

0.4

0.4

0.4

Total Dispersion, β :

0.4

0.4

0.4

0.4

0.4

Correlation (Yes / No)

NO

Data Quality Average

Documentation Quality Superior

Directionality (Yes / No)

YES

Data Relevance Average

Rationality Superior

Consequence Functions

Repair Description

Repair will typically require gouging out and re-welding of the beam flange weld, repair of shear tab, and replacing shear bolts. Repair and replace partitions at connection.

In addition to column measures for DS1, repairs to column will be necessary. Cover plate, patch, or replace damaged column flange at connection.

Repairs will be similar to those required for DS1, except that access to weld will likely require removal and replacement of a portion of the floor slab above the weld.

In addition to column measures for DS3, repairs to column will be necessary that will involve replacing a portion of the column flange.

Repair is similar to that for DS1 except that a portion of the beam web and flange may need to be heat straightened or replaced.

Long Lead Time (Yes / No)

NO

NO

NO

NO

NO

Repair Costs:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Cost by Damage State:	6.54E+03	1.26E+04	1.78E+04	7.54E+03	1.46E+04	2.08E+04	9.54E+03	1.71E+04	2.63E+04	1.11E+04	1.76E+04	2.84E+04	9.04E+03	1.46E+04	2.18E+04
Best fit mean:	1.23E+04 Normal			1.43E+04 Normal			1.76E+04 Normal			1.77E+04 LogNormal			1.43E+04 LogNormal		
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 30.00			5.00 30.00			5.00 30.00			5.00 30.00			5.00 30.00		
Average Repair Cost (Min Qty, Max Qty)	1.51E+04 1.00E+04			1.75E+04 1.16E+04			1.75E+04 1.16E+04			2.11E+04 1.41E+04			1.75E+04 1.16E+04		
CV or beta (Min Qty, Max Qty)	0.36 0.36			0.36 0.36			0.37 0.37			0.37 0.37			0.34 0.34		
Quantity Unit:	Each			Each			Each			Each			Each		
Repair Time:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Time by Damage State:	3.85E+00	7.39E+00	1.05E+01	4.44E+00	8.56E+00	1.23E+01	5.61E+00	1.00E+01	1.55E+01	6.52E+00	1.04E+01	1.67E+01	5.32E+00	8.56E+00	1.28E+01
Best fit mean:	7.39E+00 Normal			8.56E+00 Normal			1.00E+01 Normal			1.04E+01 LogNormal			8.56E+00 LogNormal		
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 30.00			5.00 30.00			5.00 30.00			5.00 30.00			5.00 30.00		
Average Repair Time (Min Qty, Max Qty)	8.87E+00 5.91E+00			1.03E+01 6.85E+00			1.17E+01 8.32E+00			1.24E+01 8.28E+00			1.03E+01 6.85E+00		
CV or beta (Min Qty, Max Qty)	0.44 0.44			0.44 0.44			0.45 0.45			0.45 0.45			0.42 0.42		
Quantity Unit:	Each			Each			Each			Each			Each		
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.5E+03	Normal	0.44	3.2E+03	Normal	0.44	4.2E+03	Normal	0.45	5.5E+03	LogNormal	0.45	1.4E+03	LogNormal	0.42
Embodied Energy (MJ)	2.1E+04	Normal	0.44	4.3E+04	Normal	0.44	6.0E+04	Normal	0.45	7.5E+04	LogNormal	0.45	2.0E+04	LogNormal	0.42
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO			NO		
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable			Not Applicable		
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00			0% 0.00		
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00			0% 0.00		
Post-event Tagging Flag:	YES			YES			YES			YES			YES		
Unsafe Placard Trigger (Median, Dispersion)	50% 0.50			50% 0.50			50% 0.50			50% 0.50			50% 0.50		

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Greg Deierlein

Revisions:

None

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1035.051

NISTIR Name

Pre-Northridge WUF-B beam-column joint, beam both sides of column, beam depth <= W27

Description

Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 96

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Number of Damage States:

5

Damage State:

DS1

DS2

DS3

DS4

DS5

Type of Damage State:

Mutually Exclusive

Mutually Exclusive

Mutually Exclusive

Mutually Exclusive

Sequential

DS Hierarchy

Seq(MutEx(DS1,DS2),MutEx(DS3,DS4),DS5)

Descriptions


Fracture of lower beam flange weld and failure of web bolts (shear tab connection), with fractures confined to the weld region.

Fracture of upper beam flange weld, without DS1 type damage. Fracture is confined to beam flange region.

Similar to DS3, except that fracture propagates into column flanges.

Fracture initiating at weld access hole and propagating through beam flange, possibly accompanied by local buckling deformations of web and flange.

Illustrations

				
B1035.041-DS1-1.JPG	B1035.041-DS2-1.JPG	none	none	none

Damage State Probability:

0.75

0.25

0.75

0.25

1.00

Fragility Parameters

Median Demand, θ :

0.017

0.017

0.025

0.025

0.03

Data dispersion, β_d :

Not Specified

Not Specified

Not Specified

Not Specified

Not Specified

Uncertainty, β_u :

0.4

0.4

0.4

0.4

0.4

Total Dispersion, β :

0.4

0.4

0.4

0.4

0.4

Correlation (Yes / No)

NO

Data Quality Average

Documentation Quality Superior

Directionality (Yes / No)

YES

Data Relevance Average

Rationality Superior

Consequence Functions

Repair Description

Repair will typically require gouging out and re-welding of the beam flange weld, repair of shear tab, and replacing shear bolts. Repair and replace partitions at connection.

In addition to column measures for DS1, repairs to column will be necessary. Cover plate, patch, or replace damaged column flange at connection.

Repairs will be similar to those required for DS1, except that access to weld will likely require removal and replacement of a portion of the floor slab above the weld.

In addition to column measures for DS3, repairs to column will be necessary that will involve replacing a portion of the column flange.

Repair is similar to that for DS1 except that a portion of the beam web and flange may need to be heat straightened or replaced.

Long Lead Time (Yes / No)

NO

NO

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	8.54E+03	1.76E+04	2.38E+04	9.54E+03	1.91E+04	2.63E+04	1.36E+04	2.46E+04	3.18E+04	1.37E+04	2.41E+04	3.29E+04	1.03E+04	1.89E+04	2.56E+04
Best fit mean:	1.67E+04 Normal			1.83E+04 Normal			2.34E+04 Normal			2.36E+04 Normal			1.83E+04 Normal		
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 30.00			5.00 30.00			5.00 30.00			5.00 30.00			5.00 30.00		
Average Repair Cost (Min Qty, Max Qty)	2.11E+04 0.36			2.29E+04 0.36			2.27E+04 0.30			2.89E+04 0.32			2.27E+04 0.33		
CV or beta (Min Qty, Max Qty)	0.36			0.36			0.30			0.32			0.33		
Quantity Unit:	Each			Each			Each			Each			Each		
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.02E+00	1.03E+01	1.40E+01	5.61E+00	1.12E+01	1.55E+01	8.02E+00	1.45E+01	1.87E+01	8.05E+00	1.42E+01	1.93E+01	6.08E+00	1.11E+01	1.51E+01
Best fit mean:	1.03E+01 Normal			1.12E+01 Normal			1.45E+01 Normal			1.42E+01 Normal			1.11E+01 Normal		
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 30.00			5.00 30.00			5.00 30.00			5.00 30.00			5.00 30.00		
Average Repair Time (Min Qty, Max Qty)	1.24E+01 0.44			1.35E+01 0.44			1.67E+01 0.39			1.70E+01 0.40			1.33E+01 0.41		
CV or beta (Min Qty, Max Qty)	0.44			0.44			0.39			0.40			0.41		
Quantity Unit:	Each			Each			Each			Each			Each		
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.6E+03	Normal	0.44	3.9E+03	Normal	0.44	8.1E+03	Normal	0.39	6.7E+03	Normal	0.40	2.6E+03	Normal	0.41
Embodied Energy (MJ)	3.5E+04	Normal	0.44	5.1E+04	Normal	0.44	1.1E+05	Normal	0.39	9.1E+04	Normal	0.40	3.5E+04	Normal	0.41
LifeSafety Hazard:	NO			NO			NO			NO			NO		
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable			Not Applicable		
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00			0% 0.00		
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00			0% 0.00		
Post-event Tagging Flag:	YES			YES			YES			YES			YES		
Unsafe Placard Trigger (Median, Dispersion)	50% 0.50			50% 0.50			50% 0.50			50% 0.50			50% 0.50		

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Greg Deierlein

Revisions:

None

Root Cost Multiplier: 1
Date Generated: 02/26/19



FEMA P-58 Fragility Specification

NISTIR Classification B1035.052
NISTIR Name Pre-Northridge WUF-B beam-column joint, beam both sides of column, beam depth >= W30
Description Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 97

Construction Quality:	Not Specified					<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>	
Seismic Installation Conditions:	Not Specified						
Fragility Unit of Measure:	EA 1						
Demand Parameter (unit):	Story Drift Ratio						
Number of Damage States:	5		Unit less				
Damage State:	DS1		DS2		DS3	DS4	DS5
Type of Damage State:	Mutually Exclusive		Mutually Exclusive		Mutually Exclusive	Mutually Exclusive	Sequential
DS Hierarchy	Seq(MutEx(DS1,DS2),MutEx(DS3,DS4),DS5)						
Descriptions	Fracture of lower beam flange weld and failure of web bolts (shear tab connection), with fractures confined to the weld region.		Similar to DS1, except that fracture propagates into column flanges.		Fracture of upper beam flange weld, without DS1 type damage. Fracture is confined to beam flange region.	Similar to DS3, except that fracture propagates into column flanges.	Fracture initiating at weld access hole and propagating through beam flange, possibly accompanied by local buckling deformations of web and flange.

Illustrations

				
B1035.041-DS1-1.JPG	B1035.041-DS2-1.JPG	none	none	none
0.75	0.25	0.75	0.25	1.00

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.017	0.017	0.025	0.025	0.03
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified	Not Specified	Not Specified
Uncertainty, β_u :	0.4	0.4	0.4	0.4	0.4
Total Dispersion, β :	0.4	0.4	0.4	0.4	0.4
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Superior	

Consequence Functions
Repair Description

Repair will typically require gouging out and re-welding of the beam flange weld, repair of shear tab, and replacing shear bolts. Repair and replace partitions at connection.

In addition to column measures for DS1, repairs to column will be necessary. Cover plate, patch, or replace damaged column flange at connection.

Repairs will be similar to those required for DS1, except that access to weld will likely require removal and replacement of a portion of the floor slab above the weld.

In addition to column measures for DS3, repairs to column will be necessary that will involve replacing a portion of the column flange.

Repair is similar to that for DS1 except that a portion of the beam web and flange may need to be heat straightened or replaced.

Long Lead Time (Yes / No)

NO NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	8.54E+03	1.76E+04	2.38E+04	9.54E+03	1.91E+04	2.63E+04	1.21E+04	2.21E+04	3.18E+04	1.37E+04	2.41E+04	3.49E+04	9.38E+03	2.39E+04	2.62E+04
Best fit mean:	1.67E+04			1.83E+04			2.20E+04			2.42E+04			1.98E+04		
Best Fit Distribution:	Normal			Normal			Normal			Normal			Normal		
Quantity Plateau (Min Qty, Max Qty)	5.00 30.00			5.00 30.00			5.00 30.00			5.00 30.00			5.00 30.00		
Average Repair Cost (Min Qty, Max Qty)	2.11E+04 0.36			2.29E+04 0.36			2.87E+04 0.35			2.89E+04 0.34			2.87E+04 0.33		
CV or beta (Min Qty, Max Qty)	Each			Each			Each			Each			Each		
Quantity Unit:															
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.02E+00	1.03E+01	1.40E+01	5.61E+00	1.12E+01	1.55E+01	7.14E+00	1.30E+01	1.87E+01	8.05E+00	1.42E+01	2.05E+01	5.52E+00	1.41E+01	1.54E+01
Best fit mean:	1.03E+01			1.12E+01			1.30E+01			1.42E+01			1.41E+01		
Best Fit Distribution:	Normal			Normal			Normal			Normal			Normal		
Quantity Plateau (Min Qty, Max Qty)	5.00 30.00			5.00 30.00			5.00 30.00			5.00 30.00			5.00 30.00		
Average Repair Time (Min Qty, Max Qty)	1.24E+01 0.44			1.35E+01 0.44			1.58E+01 0.43			1.70E+01 0.42			1.69E+01 0.41		
CV or beta (Min Qty, Max Qty)	Each			Each			Each			Each			Each		
Quantity Unit:															
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.6E+03	Normal	0.44	3.9E+03	Normal	0.44	5.4E+03	Normal	0.43	6.7E+03	Normal	0.42	4.7E+03	Normal	0.41
Embodied Energy (MJ)	3.5E+04	Normal	0.44	5.1E+04	Normal	0.44	7.4E+04	Normal	0.43	9.1E+04	Normal	0.42	5.5E+04	Normal	0.41
LifeSafety Hazard:	NO			NO			NO			NO			NO		
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable			Not Applicable			Not Applicable		
Casualty-affected Planar Area (sf) per Normative Unit:	0%			0%			0%			0%			0%		
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00			0% 0.00		
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00			0% 0.00		
Post-event Tagging Flag:	YES			YES			YES			YES			YES		
Unsafe Placard Trigger (Median, Dispersion)	50% 0.50			50% 0.50			50% 0.50			50% 0.50			50% 0.50		

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Greg Deierlein
Revisions: None

Root Cost Multiplier: 1
Date Generated: 02/26/19

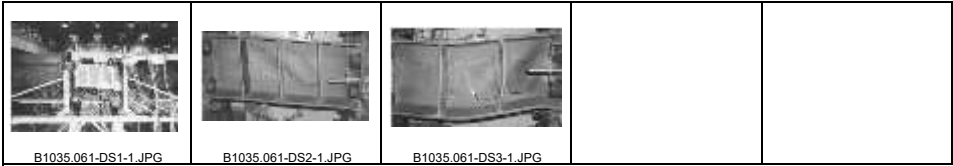
FEMA P-58 Fragility Specification

NISTIR Classification B1035.061a
NISTIR Name EBF Shear Link, no floor beams, link w < 100 PLF
Description Costing is on a per connection basis. Costing does not include fireproofing removal or reapplication cost.

Line 98

Construction Quality:	Not Specified					<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	EA 1					
Demand Parameter (unit):	Link Rotation Angle		Radians			
Number of Damage States:	3					
Damage State:	DS1		DS2		DS3	
Type of Damage State:	Sequential		Sequential		Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)					
Descriptions	Damage to concrete slab above the link beam. Web local buckling, flange local buckling. Initiation of fracture in the link beam and link flange.					

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.04	0.06	0.08		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified		
Total Dispersion, β :	0.3	0.3	0.3		
Correlation (Yes / No)	NO		Data Quality Superior	Documentation Quality Superior	
Directionality (Yes / No)	YES		Data Relevance Superior	Rationality Superior	

Consequence Functions
Repair Description

Replace concrete slab and finishes in 400 SF at EBF link. Heat straightening of buckled elements. Replace EBF link.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	4.13E+04	8.26E+04	1.00E+05	4.73E+04	8.86E+04	1.05E+05	7.05E+04	1.13E+05	1.29E+05						
Best fit mean:	7.47E+04 Normal			8.02E+04 Normal			1.04E+05 Normal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	2.00 5.00			2.00 5.00			2.00 5.00								
Average Repair Cost (Min Qty, Max Qty)	9.91E+04 6.61E+04			1.06E+05 7.09E+04			1.36E+05 9.06E+04								
CV or beta (Min Qty, Max Qty)	0.31 0.31			0.28 0.28			0.22 0.22								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.73E+01	5.47E+01	6.64E+01	3.13E+01	5.86E+01	6.94E+01	4.67E+01	7.50E+01	8.50E+01						
Best fit mean:	5.47E+01 Normal			5.86E+01 Normal			7.50E+01 Normal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	2.00 5.00			2.00 5.00			2.00 5.00								
Average Repair Time (Min Qty, Max Qty)	6.56E+01 4.37E+01			7.04E+01 4.69E+01			9.00E+01 6.00E+01								
CV or beta (Min Qty, Max Qty)	0.40 0.40			0.38 0.38			0.33 0.33								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.6E+04	Normal	0.40	2.7E+04	Normal	0.38	3.3E+04	Normal	0.33						
Embodied Energy (MJ)	3.1E+05	Normal	0.40	3.2E+05	Normal	0.38	4.9E+05	Normal	0.33						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		50%	0.50		25%	0.50							

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: None
Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR ClassificationB1035.061b

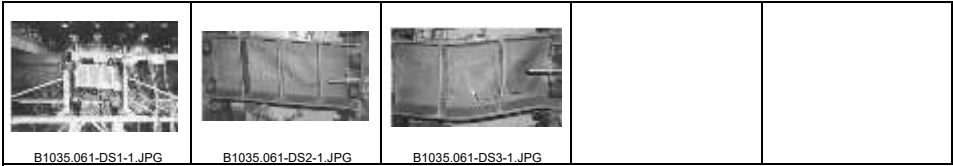
NISTIR NameEBF Shear Link, no floor beams, link w < 200 PLF

DescriptionCosting is on a per connection basis. Costing does not include fireproofing removal or reapplication cost.

Line 99

Construction Quality:	Not Specified					<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	EA 1					
Demand Parameter (unit):	Link Rotation Angle		Radians			
Number of Damage States:	3					
Damage State:	DS1		DS2		DS3	
Type of Damage State:	Sequential		Sequential		Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)					
Descriptions	Damage to concrete slab above the link beam. Web local buckling, flange local buckling. Initiation of fracture in the link beam and link flange.					

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.04	0.06	0.08		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified		
Total Dispersion, β :	0.3	0.3	0.3		
Correlation (Yes / No)	NO	Data Quality Superior	Documentation Quality Superior		
Directionality (Yes / No)	YES	Data Relevance Superior	Rationality Superior		

Consequence Functions
Repair Description

Replace concrete slab and finishes in 400 SF at EBF link. Heat straightening of buckled elements. Replace EBF link.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	4.13E+04	8.26E+04	1.00E+05	5.03E+04	9.16E+04	1.08E+05	8.25E+04	1.25E+05	1.41E+05						
Best fit mean:	7.47E+04			8.32E+04			1.16E+05								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	2.00			2.00			2.00								
Average Repair Cost (Min Qty, Max Qty)	9.91E+04			1.10E+05			1.50E+05								
CV or beta (Min Qty, Max Qty)	0.31			0.27			0.19								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.73E+01	5.47E+01	6.64E+01	3.33E+01	6.06E+01	7.13E+01	5.46E+01	8.29E+01	9.30E+01						
Best fit mean:	5.47E+01			6.06E+01			8.29E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	2.00			2.00			2.00								
Average Repair Time (Min Qty, Max Qty)	6.56E+01			7.27E+01			9.95E+01								
CV or beta (Min Qty, Max Qty)	0.40			0.37			0.32								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.6E+04	Normal	0.40	2.7E+04	Normal	0.37	3.8E+04	Normal	0.32						
Embodied Energy (MJ)	3.1E+05	Normal	0.40	3.2E+05	Normal	0.37	6.4E+05	Normal	0.32						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		50%	0.50		25%	0.50							

Comments:None

Date Created:Not Given

Approved (YES / NO)?By User

Official (YES / NO) ?By User

Author:Not Given

Revisions:None

Root Cost Multiplier:1

Date Generated:02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification B1035.062a

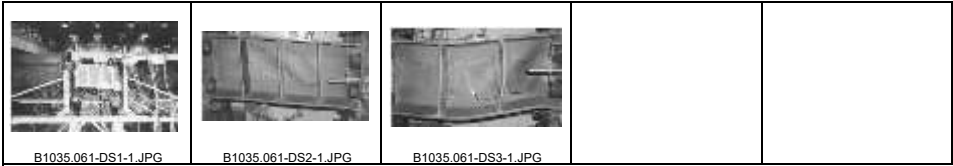
NISTIR Name EBF Shear Link, with floor beams, link w < 100 PLF

Description Costing is on a per connection basis. Costing does not include fireproofing removal or reapplication cost.

Line 100

Construction Quality:	Not Specified					<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	EA 1					
Demand Parameter (unit):	Link Rotation Angle		Radians			
Number of Damage States:	3					
Damage State:	DS1		DS2		DS3	
Type of Damage State:	Sequential		Sequential		Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)					
Descriptions	Damage to concrete slab above the link beam. Web local buckling, flange local buckling. Initiation of fracture in the link beam and link flange.					

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, δ :	0.04	0.06	0.08		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified		
Total Dispersion, β :	0.3	0.3	0.3		
Correlation (Yes / No)	NO	Data Quality Superior	Documentation Quality Superior		
Directionality (Yes / No)	YES	Data Relevance Superior	Rationality Superior		

Consequence Functions

Repair Description

Replace concrete slab and finishes in 400 SF at EBF link.

Heat straightening of buckled elements.

Replace EBF link.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	4.13E+04	8.26E+04	1.00E+05	4.73E+04	8.86E+04	1.05E+05	8.18E+04	1.26E+05	1.44E+05						
Best fit mean:	7.47E+04			8.02E+04			1.17E+05								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	2.00			2.00			2.00								
Average Repair Cost (Min Qty, Max Qty)	9.91E+04			1.06E+05			1.51E+05								
CV or beta (Min Qty, Max Qty)	0.31			0.28			0.21								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.73E+01	5.47E+01	6.64E+01	3.13E+01	5.86E+01	6.94E+01	5.41E+01	8.31E+01	9.52E+01						
Best fit mean:	5.47E+01			5.86E+01			8.31E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	2.00			2.00			2.00								
Average Repair Time (Min Qty, Max Qty)	6.56E+01			7.04E+01			9.97E+01								
CV or beta (Min Qty, Max Qty)	0.40			0.38			0.32								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.6E+04	Normal	0.40	2.7E+04	Normal	0.38	3.4E+04	Normal	0.32						
Embodied Energy (MJ)	3.1E+05	Normal	0.40	3.2E+05	Normal	0.38	5.4E+05	Normal	0.32						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		50%	0.50		25%	0.50							

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier: 1

Date Generated: 02/26/19

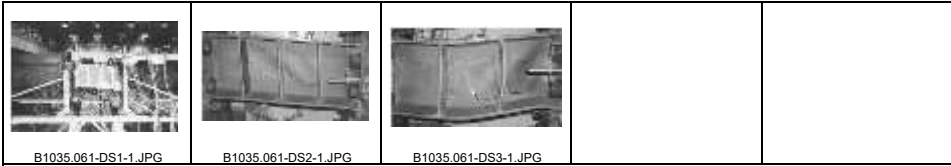
FEMA P-58 Fragility Specification

NISTIR Classification B1035.062b
NISTIR Name EBF Shear Link, with floor beams, link w < 200 PLF
Description Costing is on a per connection basis. Costing does not include fireproofing removal or reapplication cost.

Line 101

Construction Quality:	Not Specified					<div>Quantity RoundingRound Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	EA 1					
Demand Parameter (unit):	Link Rotation Angle		Radians			
Number of Damage States:	3					
Damage State:	DS1		DS2		DS3	
Type of Damage State:	Sequential		Sequential		Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)					
Descriptions	Damage to concrete slab above the link beam. Web local buckling, flange local buckling. Initiation of fracture in the link beam and link flange.					

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.04	0.06	0.08		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified		
Total Dispersion, β :	0.3	0.3	0.3		
Correlation (Yes / No)	NO		Data Quality Superior	Documentation Quality Superior	
Directionality (Yes / No)	YES		Data Relevance Superior	Rationality Superior	

Consequence Functions
Repair Description

Replace concrete slab and finishes in 400 SF at EBF link. Heat straightening of buckled elements. Replace EBF link.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	4.13E+04	8.26E+04	1.00E+05	5.03E+04	9.16E+04	1.08E+05	9.58E+04	1.41E+05	1.62E+05						
Best fit mean:	7.47E+04			8.32E+04			1.33E+05								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	2.00			2.00			2.00								
Average Repair Cost (Min Qty, Max Qty)	9.91E+04			1.10E+05			1.69E+05								
CV or beta (Min Qty, Max Qty)	0.31			0.27			0.19								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.73E+01	5.47E+01	6.64E+01	3.33E+01	6.06E+01	7.13E+01	6.34E+01	9.30E+01	1.07E+02						
Best fit mean:	5.47E+01			6.06E+01			9.30E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	2.00			2.00			2.00								
Average Repair Time (Min Qty, Max Qty)	6.56E+01			7.27E+01			1.12E+02								
CV or beta (Min Qty, Max Qty)	0.40			0.37			0.32								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.6E+04	Normal	0.40	2.7E+04	Normal	0.37	4.1E+04	Normal	0.32						
Embodied Energy (MJ)	3.1E+05	Normal	0.40	3.2E+05	Normal	0.37	7.3E+05	Normal	0.32						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		50%	0.50		25%	0.50							

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: None
Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

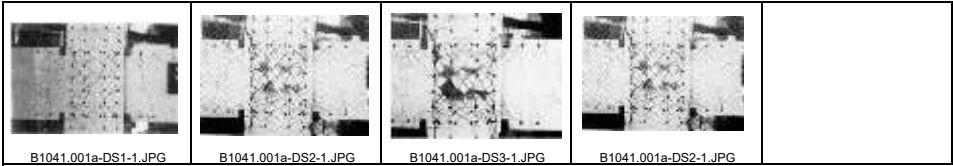
NISTIR Classification B1041.001a
NISTIR Name ACI 318 SMF , Conc Col & Bm = 24" x 24", Beam one side
Description ACI318 Concrete SMF, ductile response. Meets the requirements of ACI318 SMF. Costing is on a per joint basis.

Line 102

Construction Quality:	Not Specified			
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Story Drift Ratio			
Number of Damage States:	4			
Damage State:	DS1	DS2	DS3	DS4
Type of Damage State:	Sequential	Sequential	Mutually Exclusive	Mutually Exclusive
DS Hierarchy	Seq(DS1,DS2,MutEx(DS3,DS4))			
Descriptions	Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00	1.00	0.80	0.20
Fragility Parameters				
Median Demand, θ :	0.02	0.0275	0.05	0.05
Data dispersion, β_d :	Not Specified	0.28	0.15	0.28
Uncertainty, β_u :	0.4	0.1	0.25	0.1
Total Dispersion, β :	0.4	0.3	0.3	0.3
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Superior
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Superior

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No) NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.85E+04	3.25E+04	4.44E+04	2.30E+04	4.00E+04	5.29E+04	1.85E+04	3.25E+04	4.44E+04			
Best fit mean:	2.09E+04 Normal			3.18E+04 Normal			3.86E+04 Normal			3.18E+04 Normal					
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 1.71E+04			3.90E+04 2.60E+04			4.80E+04 3.20E+04			3.90E+04 2.60E+04					
CV or beta (Min Qty, Max Qty)	0.39 0.39			0.32 0.32			0.30 0.30			0.32 0.32					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.63E+01	2.87E+01	3.92E+01	2.03E+01	3.53E+01	4.67E+01	1.63E+01	2.87E+01	3.92E+01			
Best fit mean:	1.89E+01 Normal			2.87E+01 Normal			3.53E+01 Normal			2.87E+01 Normal					
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.27E+01 1.51E+01			3.44E+01 2.29E+01			4.23E+01 2.82E+01			3.44E+01 2.29E+01					
CV or beta (Min Qty, Max Qty)	0.46 0.46			0.40 0.40			0.39 0.39			0.40 0.40					
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	7.8E+03	Normal	0.40	9.4E+03	Normal	0.39	7.8E+03	Normal	0.40			
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.1E+05	Normal	0.40	1.6E+05	Normal	0.39	1.1E+05	Normal	0.40			
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			NO			YES			NO					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			20% 0.50			0% 0.00					

Comments: Note: DS4 is a copy of DS2 to create a mutually exclusive compliment to DS3.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: None

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

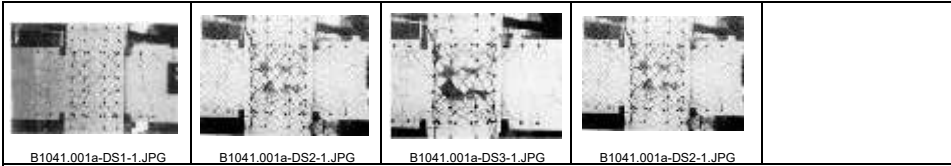
NISTIR Classification B1041.001b
NISTIR Name ACI 318 SMF , Conc Col & Bm = 24" x 24", Beam both sides
Description ACI318 Concrete SMF, ductile response. Meets the requirements of ACI318 SMF. Costing is on a per joint basis.

Line 103

Construction Quality:	Not Specified			
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Story Drift Ratio			
Number of Damage States:	4			
Damage State:	DS1	DS2	DS3	DS4
Type of Damage State:	Sequential	Sequential	Mutually Exclusive	Mutually Exclusive
DS Hierarchy	Seq(DS1,DS2,MutEx(DS3,DS4))			
Descriptions	Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00	1.00	0.80	0.20
Fragility Parameters				
Median Demand, θ :	0.02	0.0275	0.05	0.05
Data dispersion, β_d :	Not Specified	0.28	0.15	0.28
Uncertainty, β_u :	0.4	0.1	0.25	0.1
Total Dispersion, β :	0.4	0.3	0.3	0.3
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Superior
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Superior

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.85E+04	3.25E+04	4.44E+04	2.30E+04	4.00E+04	5.29E+04	1.85E+04	3.25E+04	4.44E+04			
Best fit mean:	2.09E+04 Normal			3.18E+04 Normal			3.86E+04 Normal			3.18E+04 Normal					
Best Fit Distribution:	5.00			5.00			5.00			5.00					
Quantity Plateau (Min Qty, Max Qty)	2.57E+04			3.90E+04			4.80E+04			3.90E+04					
Average Repair Cost (Min Qty, Max Qty)	0.39			0.32			0.30			0.32					
CV or beta (Min Qty, Max Qty)	Each			Each			Each			Each					
Quantity Unit:															
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.63E+01	2.87E+01	3.92E+01	2.03E+01	3.53E+01	4.67E+01	1.63E+01	2.87E+01	3.92E+01			
Best fit mean:	1.89E+01 Normal			2.87E+01 Normal			3.53E+01 Normal			2.87E+01 Normal					
Best Fit Distribution:	5.00			5.00			5.00			5.00					
Quantity Plateau (Min Qty, Max Qty)	2.27E+01			3.44E+01			4.23E+01			3.44E+01					
Average Repair Time (Min Qty, Max Qty)	0.46			0.40			0.39			0.40					
CV or beta (Min Qty, Max Qty)	Each			Each			Each			Each					
Quantity Unit:															
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	4.9E+03	Normal	0.46	7.8E+03	Normal	0.40	9.4E+03	Normal	0.39	7.8E+03	Normal	0.40			
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.1E+05	Normal	0.40	1.6E+05	Normal	0.39	1.1E+05	Normal	0.40			
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Casualty-affected Planar Area (sf) per Normative Unit:	0%			0%			0%			0%					
Serious Injury (Median, Dispersion)	0%			0%			0%			0%					
Loss of Life (Median, Dispersion)	0%			0%			0%			0%					
Post-event Tagging Flag:	NO			NO			YES			NO					
Unsafe Placard Trigger (Median, Dispersion)	0%			0%			20%			0%					

Comments: Note: DS4 is a copy of DS2 to create a mutually exclusive compliment to DS3.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: None

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

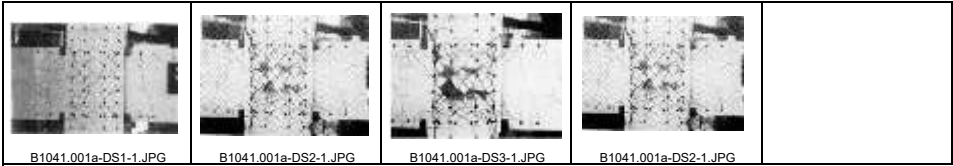
NISTIR Classification B1041.002a
NISTIR Name ACI 318 SMF , Conc Col & Bm = 24" x 36", Beam one side
Description ACI318 Concrete SMF, ductile response. Meets the requirements of ACI318 SMF. Costing is on a per joint basis.

Line 104

Construction Quality:	Not Specified			
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Story Drift Ratio			
Number of Damage States:	4			
Damage State:	DS1	DS2	DS3	DS4
Type of Damage State:	Sequential	Sequential	Mutually Exclusive	Mutually Exclusive
DS Hierarchy	Seq(DS1,DS2,MutEx(DS3,DS4))			
Descriptions	Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00	1.00	0.80	0.20
Fragility Parameters				
Median Demand, θ :	0.02	0.0275	0.05	0.05
Data dispersion, β_d :	Not Specified	0.28	0.15	0.28
Uncertainty, β_u :	0.4	0.1	0.25	0.1
Total Dispersion, β :	0.4	0.3	0.3	0.3
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Superior
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Superior

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No) NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04	1.95E+04	3.45E+04	4.54E+04			
Best fit mean:	2.09E+04			3.31E+04			3.96E+04			3.31E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 1.71E+04			4.14E+04 2.76E+04			4.92E+04 3.28E+04			4.14E+04 2.76E+04					
CV or beta (Min Qty, Max Qty)	0.39 0.39			0.31 0.31			0.29 0.29			0.31 0.31					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01	1.72E+01	3.04E+01	4.01E+01			
Best fit mean:	1.89E+01			3.04E+01			3.62E+01			3.04E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.27E+01 1.51E+01			3.65E+01 2.43E+01			4.34E+01 2.89E+01			3.65E+01 2.43E+01					
CV or beta (Min Qty, Max Qty)	0.46 0.46			0.39 0.39			0.39 0.39			0.39 0.39					
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	8.3E+03	Normal	0.39	9.6E+03	Normal	0.39	8.3E+03	Normal	0.39			
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.2E+05	Normal	0.39	1.7E+05	Normal	0.39	1.2E+05	Normal	0.39			
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			NO			YES			NO					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			20% 0.50			0% 0.00					

Comments: Note: DS4 is a copy of DS2 to create a mutually exclusive compliment to DS3.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: None

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

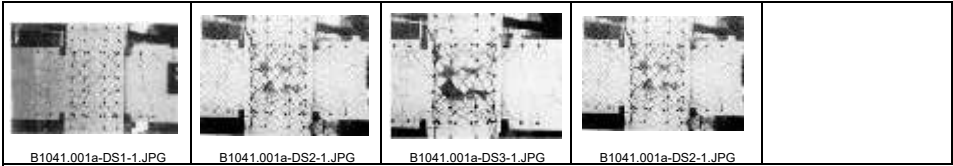
NISTIR Classification B1041.002b
NISTIR Name ACI 318 SMF , Conc Col & Bm = 24" x 36", Beam both sides
Description ACI318 Concrete SMF, ductile response. Meets the requirements of ACI318 SMF. Costing is on a per joint basis.

Line 105

Construction Quality:	Not Specified			
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Story Drift Ratio			
Number of Damage States:	4			
Damage State:	DS1	DS2	DS3	DS4
Type of Damage State:	Sequential	Sequential	Mutually Exclusive	Mutually Exclusive
DS Hierarchy	Seq(DS1,DS2,MutEx(DS3,DS4))			
Descriptions	Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00	1.00	0.80	0.20
Fragility Parameters				
Median Demand, θ :	0.02	0.0275	0.05	0.05
Data dispersion, β_d :	Not Specified	0.28	0.15	0.28
Uncertainty, β_u :	0.4	0.1	0.25	0.1
Total Dispersion, β :	0.4	0.3	0.3	0.3
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Superior
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Superior

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04	1.95E+04	3.45E+04	4.54E+04			
Best fit mean:	2.09E+04			3.31E+04			3.96E+04			3.31E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 1.71E+04			4.14E+04 2.76E+04			4.92E+04 3.28E+04			4.14E+04 2.76E+04					
CV or beta (Min Qty, Max Qty)	0.39 0.39			0.31 0.31			0.29 0.29			0.31 0.31					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01	1.72E+01	3.04E+01	4.01E+01			
Best fit mean:	1.89E+01			3.04E+01			3.62E+01			3.04E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.27E+01 1.51E+01			3.65E+01 2.43E+01			4.34E+01 2.89E+01			3.65E+01 2.43E+01					
CV or beta (Min Qty, Max Qty)	0.46 0.46			0.39 0.39			0.39 0.39			0.39 0.39					
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	8.3E+03	Normal	0.39	9.6E+03	Normal	0.39	8.3E+03	Normal	0.39			
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.2E+05	Normal	0.39	1.7E+05	Normal	0.39	1.2E+05	Normal	0.39			
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			NO			YES			NO					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			20% 0.50			0% 0.00					

Comments: Note: DS4 is a copy of DS2 to create a mutually exclusive compliment to DS3.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: None

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

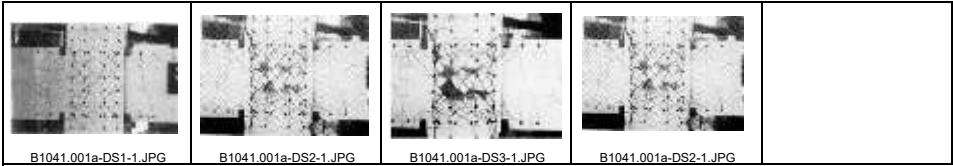
NISTIR Classification B1041.003a
NISTIR Name ACI 318 SMF , Conc Col & Bm = 36" x 36", Beam one side
Description ACI318 Concrete SMF, ductile response. Meets the requirements of ACI318 SMF. Costing is on a per joint basis.

Line 106

Construction Quality:	Not Specified			
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Story Drift Ratio			
Number of Damage States:	4			
Damage State:	DS1	DS2	DS3	DS4
Type of Damage State:	Sequential	Sequential	Mutually Exclusive	Mutually Exclusive
DS Hierarchy	Seq(DS1,DS2,MutEx(DS3,DS4))			
Descriptions	Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00	1.00	0.80	0.20
Fragility Parameters				
Median Demand, θ :	0.02	0.0275	0.05	0.05
Data dispersion, β_d :	Not Specified	0.28	0.15	0.28
Uncertainty, β_u :	0.4	0.1	0.25	0.1
Total Dispersion, β :	0.4	0.3	0.3	0.3
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Superior
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Superior

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04	1.95E+04	3.45E+04	4.54E+04			
Best fit mean:	2.09E+04			3.31E+04			3.96E+04			3.31E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 1.71E+04			4.14E+04 2.76E+04			4.92E+04 3.28E+04			4.14E+04 2.76E+04					
CV or beta (Min Qty, Max Qty)	0.39 0.39			0.31 0.31			0.29 0.29			0.31 0.31					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01	1.72E+01	3.04E+01	4.01E+01			
Best fit mean:	1.89E+01			3.04E+01			3.62E+01			3.04E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.27E+01 1.51E+01			3.65E+01 2.43E+01			4.34E+01 2.89E+01			3.65E+01 2.43E+01					
CV or beta (Min Qty, Max Qty)	0.46 0.46			0.39 0.39			0.39 0.39			0.39 0.39					
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	8.3E+03	Normal	0.39	9.6E+03	Normal	0.39	8.3E+03	Normal	0.39			
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.2E+05	Normal	0.39	1.7E+05	Normal	0.39	1.2E+05	Normal	0.39			
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			NO			YES			NO					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			20% 0.50			0% 0.00					

Comments: Note: DS4 is a copy of DS2 to create a mutually exclusive compliment to DS3.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: None

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

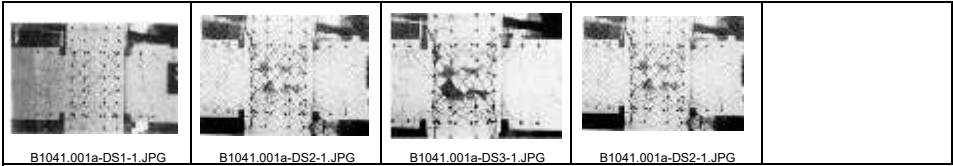
NISTIR Classification B1041.003b
NISTIR Name ACI 318 SMF , Conc Col & Bm = 36" x 36", Beam both sides
Description ACI318 Concrete SMF, ductile response. Meets the requirements of ACI318 SMF. Costing is on a per joint basis.

Line 107

Construction Quality:	Not Specified			
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Story Drift Ratio			
Number of Damage States:	4			
Damage State:	DS1	DS2	DS3	DS4
Type of Damage State:	Sequential	Sequential	Mutually Exclusive	Mutually Exclusive
DS Hierarchy	Seq(DS1,DS2,MutEx(DS3,DS4))			
Descriptions	Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00	1.00	0.80	0.20
Fragility Parameters				
Median Demand, θ :	0.02	0.0275	0.05	0.05
Data dispersion, β_d :	Not Specified	0.28	0.15	0.28
Uncertainty, β_u :	0.4	0.1	0.25	0.1
Total Dispersion, β :	0.4	0.3	0.3	0.3
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Superior
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Superior

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04	1.95E+04	3.45E+04	4.54E+04			
Best fit mean:	2.09E+04			3.31E+04			3.96E+04			3.31E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 1.71E+04			4.14E+04 2.76E+04			4.92E+04 3.28E+04			4.14E+04 2.76E+04					
CV or beta (Min Qty, Max Qty)	0.39 0.39			0.31 0.31			0.29 0.29			0.31 0.31					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01	1.72E+01	3.04E+01	4.01E+01			
Best fit mean:	1.89E+01			3.04E+01			3.62E+01			3.04E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.27E+01 1.51E+01			3.65E+01 2.43E+01			4.34E+01 2.89E+01			3.65E+01 2.43E+01					
CV or beta (Min Qty, Max Qty)	0.46 0.46			0.39 0.39			0.39 0.39			0.39 0.39					
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	8.3E+03	Normal	0.39	9.6E+03	Normal	0.39	8.3E+03	Normal	0.39			
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.2E+05	Normal	0.39	1.7E+05	Normal	0.39	1.2E+05	Normal	0.39			
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			NO			YES			NO					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			20% 0.50			0% 0.00					

Comments: Note: DS4 is a copy of DS2 to create a mutually exclusive compliment to DS3.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: None

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.011a

NISTIR Name

MF with SMF-conforming beam and column flexural and confinement reinforcement but weak joints , Conc Col & Bm = 24" x 24", Beam one side

Description

Non-conforming SMF, joint shear damage, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) Column Pu < 0.6f'cAg, (3) Column flexural response with HIGH ductility, (4) Beam compliant transverse reinforcing with low beam V/bwd(f'c)^0.5, (5) Joints with compliant transverse reinforcing details with spacing < d(column)/2 and Joint V/Vn < 1.2. Costing is on a per joint basis.

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding Round Qty? YES

Allow sum by floor or building? NO

Demand Location (floor above?) No

Number of Damage States:

4

Damage State:

DS1

DS2

DS3

DS4

Type of Damage State:

Sequential

Sequential

Mutually Exclusive

Mutually Exclusive

DS Hierarchy

Seq(DS1,DS2,MutEx(DS3,DS4))

Descriptions

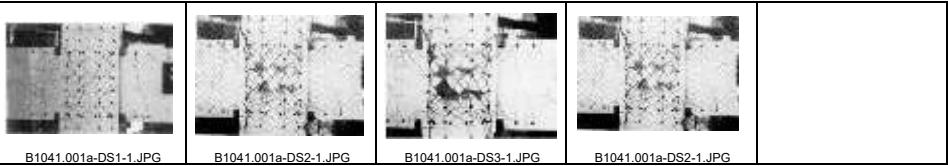
Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.

Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.

Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

Illustrations



Damage State Probability:

1.00

1.00

0.50

0.50

Fragility Parameters

Median Demand, θ :

0.02

0.025

0.04

0.04

Data dispersion, β_d :

0.07

0.30

0.2

0.3

Uncertainty, β_u :

0.4

0.1

0.25

0.1

Total Dispersion, β :

0.4

0.3

0.3

Correlation (Yes / No)

NO

Directionality (Yes / No)

YES

Data Quality Average

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.85E+04	3.25E+04	4.44E+04	2.30E+04	4.00E+04	5.29E+04	1.85E+04	3.25E+04	4.44E+04			
Best fit mean:	2.09E+04 Normal			3.18E+04 Normal			3.86E+04 Normal			3.18E+04 Normal					
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 1.71E+04			3.90E+04 2.60E+04			4.80E+04 3.20E+04			3.90E+04 2.60E+04					
CV or beta (Min Qty, Max Qty)	0.39 0.39			0.32 0.32			0.30 0.30			0.32 0.32					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.63E+01	2.87E+01	3.92E+01	2.03E+01	3.53E+01	4.67E+01	1.63E+01	2.87E+01	3.92E+01			
Best fit mean:	1.89E+01 Normal			2.87E+01 Normal			3.53E+01 Normal			2.87E+01 Normal					
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.27E+01 1.51E+01			3.44E+01 2.29E+01			4.23E+01 2.82E+01			3.44E+01 2.29E+01					
CV or beta (Min Qty, Max Qty)	0.46 0.46			0.40 0.40			0.39 0.39			0.40 0.40					
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	4.9E+03	Normal	0.46	7.8E+03	Normal	0.40	9.4E+03	Normal	0.39	7.8E+03	Normal	0.40			
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.1E+05	Normal	0.40	1.6E+05	Normal	0.39	1.1E+05	Normal	0.40			
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			NO			YES			NO					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			20% 0.50			0% 0.00					

Comments:

Note: DS4 is a copy of DS2 to create a mutually exclusive compliment to DS3.

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Laura Lowes

Revisions:

None

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.011b

NISTIR Name
Description

MF with SMF-conforming beam and column flexural and confinement reinforcement but weak joints , Conc Col & Bm = 24" x 24", Beam both sides
Non-conforming SMF, joint shear damage, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) Column Pu < 0.6f'cAg, (3) Column flexural response with HIGH ductility, (4) Beam compliant transverse reinforcing with low beam V/bwlf'c)>0.5, (5) Joints with compliant transverse reinforcing details with spacing < d(column)/2 and Joint V/Vn < 1.2. Costing is on a per joint basis.

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding Round Qty? YES
Allow sum by floor or building? NO
Demand Location (floor above?) No

Number of Damage States:

4

Damage State:

DS1

DS2

DS3

DS4

Type of Damage State:

Sequential

Sequential

Mutually Exclusive

Mutually Exclusive

DS Hierarchy

Seq(DS1,DS2,MutEx(DS3,DS4))

Descriptions

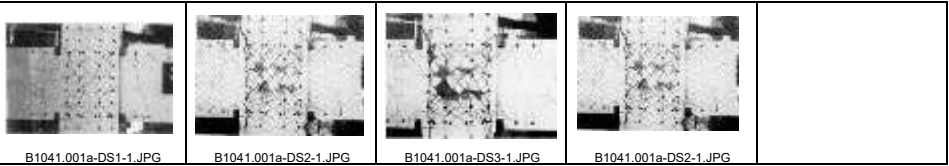
Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.

Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.

Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

Illustrations



Damage State Probability:

1.00

1.00

0.50

0.50

Fragility Parameters

Median Demand, θ :

0.02

0.025

0.04

0.04

Data dispersion, β_d :

0.07

0.30

0.2

0.3

Uncertainty, β_u :

0.4

0.1

0.25

0.1

Total Dispersion, β :

0.4

0.3

0.3

Correlation (Yes / No)

NO

Directionality (Yes / No)

YES

Data Quality Average

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

NO

Repair Costs:

	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.85E+04	3.25E+04	4.44E+04	2.30E+04	4.00E+04	5.29E+04	1.85E+04	3.25E+04	4.44E+04			
Best fit mean:	2.09E+04 Normal			3.18E+04 Normal			3.86E+04 Normal			3.18E+04 Normal					
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 1.71E+04			3.90E+04 2.60E+04			4.80E+04 3.20E+04			3.90E+04 2.60E+04					
CV or beta (Min Qty, Max Qty)	0.39 0.39			0.32 0.32			0.30 0.30			0.32 0.32					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.63E+01	2.87E+01	3.92E+01	2.03E+01	3.53E+01	4.67E+01	1.63E+01	2.87E+01	3.92E+01			
Best fit mean:	1.89E+01 Normal			2.87E+01 Normal			3.53E+01 Normal			2.87E+01 Normal					
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.27E+01 1.51E+01			3.44E+01 2.29E+01			4.23E+01 2.82E+01			3.44E+01 2.29E+01					
CV or beta (Min Qty, Max Qty)	0.46 0.46			0.40 0.40			0.39 0.39			0.40 0.40					
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	4.9E+03	Normal	0.46	7.8E+03	Normal	0.40	9.4E+03	Normal	0.39	7.8E+03	Normal	0.40			
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.1E+05	Normal	0.40	1.6E+05	Normal	0.39	1.1E+05	Normal	0.40			
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			NO			YES			NO					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			20% 0.50			0% 0.00					

Comments:

Note: DS4 is a copy of DS2 to create a mutually exclusive compliment to DS3.

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Laura Lowes

Revisions:

None

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.012a

Line 110

NISTIR Name
Description

MF with SMF-conforming beam and column flexural and confinement reinforcement but weak joints , Conc Col & Bm = 24" x 36", Beam one side
Non-conforming SMF, joint shear damage, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) Column Pu < 0.6f'cAg, (3) Column flexural response with HIGH ductility, (4) Beam compliant transverse reinforcing with low beam V/bwdf'c)>0.5, (5) Joints with compliant transverse reinforcing details with spacing < d(column)/2 and Joint V/Vn < 1.2. Costing is on a per joint basis.

Construction Quality:

Not Specified

Seismic Installation Conditions:

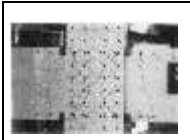
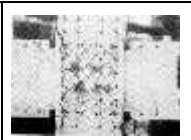
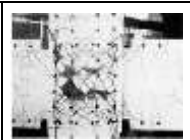
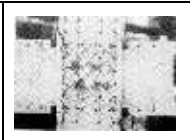
Not Specified

Fragility Unit of Measure:	EA 1
Demand Parameter (unit):	Story Drift Ratio
Number of Damage States:	4

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Mutually Exclusive	Mutually Exclusive	
DS Hierarchy	Seq(DS1,DS2,MutEx(DS3,DS4))				
Descriptions	Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	

Illustrations

				
B1041.001a-DS1-1.JPG	B1041.001a-DS2-1.JPG	B1041.001a-DS3-1.JPG	B1041.001a-DS2-1.JPG	
1.00	1.00	0.50	0.50	

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.02	0.025	0.04	0.04	
Data dispersion, β_d :	0.07	0.30	0.2	0.3	
Uncertainty, β_u :	0.4	0.1	0.25	0.1	
Total Dispersion, β :	0.4	0.3	0.3	0.3	
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Superior	

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04	1.95E+04	3.45E+04	4.54E+04			
Best fit mean:	2.09E+04			3.31E+04			3.96E+04			3.31E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 1.71E+04			4.14E+04 2.76E+04			4.92E+04 3.28E+04			4.14E+04 2.76E+04					
CV or beta (Min Qty, Max Qty)	0.39 0.39			0.31 0.31			0.29 0.29			0.31 0.31					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01	1.72E+01	3.04E+01	4.01E+01			
Best fit mean:	1.89E+01			3.04E+01			3.62E+01			3.04E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.27E+01 1.51E+01			3.65E+01 2.43E+01			4.34E+01 2.89E+01			3.65E+01 2.43E+01					
CV or beta (Min Qty, Max Qty)	0.46 0.46			0.39 0.39			0.39 0.39			0.39 0.39					
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	8.3E+03	Normal	0.39	9.6E+03	Normal	0.39	8.3E+03	Normal	0.39			
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.2E+05	Normal	0.39	1.7E+05	Normal	0.39	1.2E+05	Normal	0.39			
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			NO			YES			NO					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			20% 0.50			0% 0.00					

Comments:

Note: DS4 is a copy of DS2 to create a mutually exclusive compliment to DS3.

Date Created:
Approved (YES / NO)?
Official (YES / NO) ?
Author:
Revisions:

Not Given
By User
By User
Laura Lowes
None

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.012b

NISTIR Name
Description

MF with SMF-conforming beam and column flexural and confinement reinforcement but weak joints , Conc Col & Bm = 24" x 36", Beam both sides
Non-conforming SMF, joint shear damage, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) Column Pu < 0.6f'cAg, (3) Column flexural response with HIGH ductility, (4) Beam compliant transverse reinforcing with low beam V/bwlf'c)>0.5, (5) Joints with compliant transverse reinforcing details with spacing < d(column)/2 and Joint V/Vn < 1.2. Costing is on a per joint basis.

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding Round Qty? YES
Allow sum by floor or building? NO
Demand Location (floor above)? No

Number of Damage States:

4

Damage State:

DS1

DS2

DS3

DS4

Type of Damage State:

Sequential

Sequential

Mutually Exclusive

Mutually Exclusive

DS Hierarchy

Seq(DS1,DS2,MutEx(DS3,DS4))

Descriptions

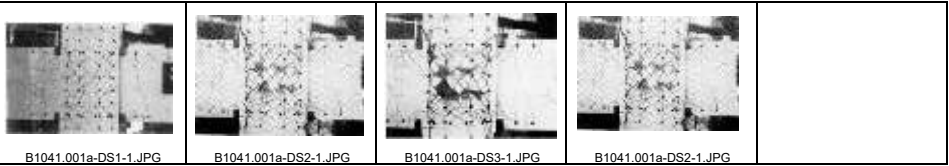
Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.

Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.

Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

Illustrations



Damage State Probability:

1.00

1.00

0.50

0.50

Fragility Parameters

Median Demand, θ :

0.02

0.025

0.04

0.04

Data dispersion, β_d :

0.07

0.30

0.2

0.3

Uncertainty, β_u :

0.4

0.1

0.25

0.1

Total Dispersion, β :

0.4

0.3

0.3

Correlation (Yes / No)

NO

Directionality (Yes / No)

YES

Data Quality Average

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04	1.95E+04	3.45E+04	4.54E+04			
Best fit mean:	2.09E+04 Normal			3.31E+04 Normal			3.96E+04 Normal			3.31E+04 Normal					
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 1.71E+04			4.14E+04 2.76E+04			4.92E+04 3.28E+04			4.14E+04 2.76E+04					
CV or beta (Min Qty, Max Qty)	0.39 0.39			0.31 0.31			0.29 0.29			0.31 0.31					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01	1.72E+01	3.04E+01	4.01E+01			
Best fit mean:	1.89E+01 Normal			3.04E+01 Normal			3.62E+01 Normal			3.04E+01 Normal					
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.27E+01 1.51E+01			3.65E+01 2.43E+01			4.34E+01 2.89E+01			3.65E+01 2.43E+01					
CV or beta (Min Qty, Max Qty)	0.46 0.46			0.39 0.39			0.39 0.39			0.39 0.39					
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	8.3E+03	Normal	0.39	9.6E+03	Normal	0.39	8.3E+03	Normal	0.39			
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.2E+05	Normal	0.39	1.7E+05	Normal	0.39	1.2E+05	Normal	0.39			
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			NO			YES			NO					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			20% 0.50			0% 0.00					

Comments:

Note: DS4 is a copy of DS2 to create a mutually exclusive compliment to DS3.

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Laura Lowes

Revisions:

None

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.013a

Line 112

NISTIR Name
Description

MF with SMF-conforming beam and column flexural and confinement reinforcement but weak joints , Conc Col & Bm = 36" x 36", Beam one side
Non-conforming SMF, joint shear damage, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) Column Pu < 0.6f'cAg, (3) Column flexural response with HIGH ductility, (4) Beam compliant transverse reinforcing with low beam V/bwd(f'c)^0.5, (5) Joints with compliant transverse reinforcing details with spacing < d(column)/2 and Joint V/Vn < 1.2. Costing is on a per joint basis.

Construction Quality:
Seismic Installation Conditions:

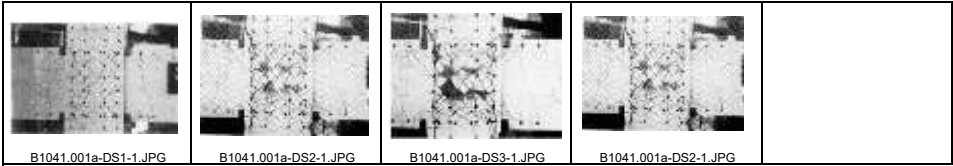
Not Specified
Not Specified

Fragility Unit of Measure:	EA 1
Demand Parameter (unit):	Story Drift Ratio
Number of Damage States:	4

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Mutually Exclusive	Mutually Exclusive	
DS Hierarchy	Seq(DS1,DS2,MutEx(DS3,DS4))				
Descriptions	Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	

Illustrations



Damage State Probability:	1.00	1.00	0.50	0.50	
Fragility Parameters					
Median Demand, θ :	0.02	0.025	0.04	0.04	
Data dispersion, β_d :	0.07	0.30	0.2	0.3	
Uncertainty, β_u :	0.4	0.1	0.25	0.1	
Total Dispersion, β :	0.4	0.3	0.3	0.3	
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Superior	

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04	1.95E+04	3.45E+04	4.54E+04			
Best fit mean:	2.09E+04			3.31E+04			3.96E+04			3.31E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 1.71E+04			4.14E+04 2.76E+04			4.92E+04 3.28E+04			4.14E+04 2.76E+04					
CV or beta (Min Qty, Max Qty)	0.39 0.39			0.31 0.31			0.29 0.29			0.31 0.31					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01	1.72E+01	3.04E+01	4.01E+01			
Best fit mean:	1.89E+01			3.04E+01			3.62E+01			3.04E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.27E+01 1.51E+01			3.65E+01 2.43E+01			4.34E+01 2.89E+01			3.65E+01 2.43E+01					
CV or beta (Min Qty, Max Qty)	0.46 0.46			0.39 0.39			0.39 0.39			0.39 0.39					
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	8.3E+03	Normal	0.39	9.6E+03	Normal	0.39	8.3E+03	Normal	0.39			
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.2E+05	Normal	0.39	1.7E+05	Normal	0.39	1.2E+05	Normal	0.39			
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			NO			YES			NO					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			20% 0.50			0% 0.00					

Comments:

Note: DS4 is a copy of DS2 to create a mutually exclusive compliment to DS3.

Date Created:
Approved (YES / NO)?
Official (YES / NO) ?
Author:
Revisions:

Not Given
By User
By User
Laura Lowes
None

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.013b

NISTIR Name
Description

MF with SMF-conforming beam and column flexural and confinement reinforcement but weak joints , Conc Col & Bm = 36" x 36", Beam both sides
Non-conforming SMF, joint shear damage, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) Column Pu < 0.6f'cAg, (3) Column flexural response with HIGH ductility, (4) Beam compliant transverse reinforcing with low beam V/bwd(f'c)^0.5, (5) Joints with compliant transverse reinforcing details with spacing < d(column)/2 and Joint V/Vn < 1.2. Costing is on a per joint basis.

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding Round Qty? YES
Allow sum by floor or building? NO
Demand Location (floor above)? No

Number of Damage States:

4

Damage State:

DS1

DS2

DS3

DS4

Type of Damage State:

Sequential

Sequential

Mutually Exclusive

Mutually Exclusive

DS Hierarchy

Seq(DS1,DS2,MutEx(DS3,DS4))

Descriptions

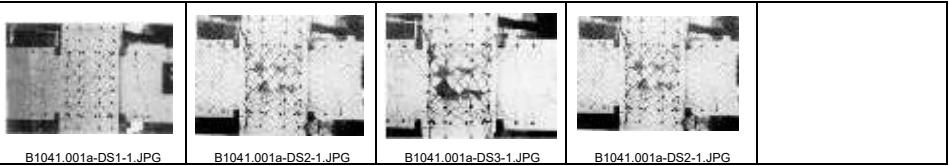
Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.

Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.

Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

Illustrations



Damage State Probability:

1.00

1.00

0.50

0.50

Fragility Parameters

Median Demand, θ :

0.02

0.025

0.04

0.04

Data dispersion, β_d :

0.07

0.30

0.2

0.3

Uncertainty, β_u :

0.4

0.1

0.25

0.1

Total Dispersion, β :

0.4

0.3

0.3

Correlation (Yes / No)

NO

Directionality (Yes / No)

YES

Data Quality Average

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged area. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

NO

Repair Costs:

	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04	1.95E+04	3.45E+04	4.54E+04			
Best fit mean:	2.09E+04 Normal			3.31E+04 Normal			3.96E+04 Normal			3.31E+04 Normal					
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 1.71E+04			4.14E+04 2.76E+04			4.92E+04 3.28E+04			4.14E+04 2.76E+04					
CV or beta (Min Qty, Max Qty)	0.39 0.39			0.31 0.31			0.29 0.29			0.31 0.31					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01	1.72E+01	3.04E+01	4.01E+01			
Best fit mean:	1.89E+01 Normal			3.04E+01 Normal			3.62E+01 Normal			3.04E+01 Normal					
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.27E+01 1.51E+01			3.65E+01 2.43E+01			4.34E+01 2.89E+01			3.65E+01 2.43E+01					
CV or beta (Min Qty, Max Qty)	0.46 0.46			0.39 0.39			0.39 0.39			0.39 0.39					
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	8.3E+03	Normal	0.39	9.6E+03	Normal	0.39	8.3E+03	Normal	0.39			
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.2E+05	Normal	0.39	1.7E+05	Normal	0.39	1.2E+05	Normal	0.39			
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			NO			YES			NO					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			20% 0.50			0% 0.00					

Comments:

Note: DS4 is a copy of DS2 to create a mutually exclusive compliment to DS3.

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

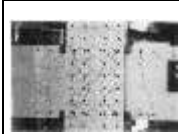


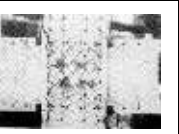
Laura Lowes

Revisions:

None

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification		B1041.021a				Line 114
NISTIR Name		ACI 318 IMF, Conc Col & Bm = 24" x 24", Beam one side				
Description		ACI318 IMF, joint shear damage or failure, beam or column flexure-shear response. Meets the following requirements: (1) Column Pu < 0.3Agf'c. Costing is on a per joint basis.				
Construction Quality:		Not Specified				
Seismic Installation Conditions:		Not Specified				
Fragility Unit of Measure:		EA 1				Quantity Rounding Round Qty? YES
Demand Parameter (unit):		Story Drift Ratio				Allow sum by floor or building? NO
Number of Damage States:		4				Demand Location (floor above?) No
Damage State:		DS1	DS2	DS3	DS4	
Type of Damage State:		Sequential	Sequential	Mutually Exclusive	Mutually Exclusive	
DS Hierarchy		Seq(DS1,DS2,MutEx(DS3,DS4))				
Descriptions		Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	
Illustrations						
Damage State Probability:		1.00	1.00	0.40	0.60	
Fragility Parameters						
Median Demand, B:		0.02	0.025	0.035	0.035	
Data dispersion, B_d:		0.06	0.30	0.2	0.3	
Uncertainty, B_u:		0.4	0.1	0.1	0.1	
Total Dispersion, B_t:		0.4	0.3	0.3	0.3	
Correlation (Yes / No)		NO	Data Quality Average		Documentation Quality Superior	
Directionality (Yes / No)		YES	Data Relevance Average		Rationality Superior	
Consequence Functions						
Repair Description		Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	
Long Lead Time (Yes / No)		NO	NO	NO	NO	
Repair Costs:		P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀
Repair Cost by Damage State:		1.02E+04 2.14E+04 3.11E+04	1.85E+04 3.25E+04 4.44E+04	2.30E+04 4.00E+04 5.29E+04	1.85E+04 3.25E+04 4.44E+04	
Best fit mean:		2.09E+04	3.18E+04	3.86E+04	3.18E+04	
Best Fit Distribution:		Normal	Normal	Normal	Normal	
Quantity Plateau (Min Qty, Max Qty)		5.00 20.00	5.00 20.00	5.00 20.00	5.00 20.00	
Average Repair Cost (Min Qty, Max Qty)		2.57E+04 1.71E+04	3.90E+04 2.60E+04	4.80E+04 3.20E+04	3.90E+04 2.60E+04	
CV or beta (Min Qty, Max Qty)		0.39 0.39	0.32 0.32	0.30 0.30	0.32 0.32	
Quantity Unit:		Each	Each	Each	Each	
Repair Time:		P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀
Repair Time by Damage State:		8.98E+00 1.89E+01 2.75E+01	1.63E+01 2.87E+01 3.92E+01	2.03E+01 3.53E+01 4.67E+01	1.63E+01 2.87E+01 3.92E+01	
Best fit mean:		1.89E+01	2.87E+01	3.53E+01	2.87E+01	
Best Fit Distribution:		Normal	Normal	Normal	Normal	
Quantity Plateau (Min Qty, Max Qty)		5.00 20.00	5.00 20.00	5.00 20.00	5.00 20.00	
Average Repair Time (Min Qty, Max Qty)		2.27E+01 1.51E+01	3.44E+01 2.29E+01	4.23E+01 2.82E+01	3.44E+01 2.29E+01	
CV or beta (Min Qty, Max Qty)		0.46 0.46	0.40 0.40	0.39 0.39	0.40 0.40	
Quantity Unit:		Each	Each	Each	Each	
Environmental Impacts:		Median Cost Best Fit CV or Beta	Median Cost Best Fit CV or Beta	Median Cost Best Fit CV or Beta	Median Cost Best Fit CV or Beta	Median Cost Best Fit CV or Beta
Embodied Carbon (kg CO2eq)		4.9E+03 Normal 0.46	7.8E+03 Normal 0.40	9.4E+03 Normal 0.39	7.8E+03 Normal 0.40	
Embodied Energy (MJ)		7.3E+04 Normal 0.46	1.1E+05 Normal 0.40	1.6E+05 Normal 0.39	1.1E+05 Normal 0.40	
LifeSafety Hazard:						
Potential non-collapse casualties? (Yes / No)		NO	NO	NO	NO	
Casualty-affected Planar Area (sf) per Normative Unit:		Not Applicable	Not Applicable	Not Applicable	Not Applicable	
Serious Injury (Median, Dispersion)		0% 0.00	0% 0.00	0% 0.00	0% 0.00	
Loss of Life (Median, Dispersion)		0% 0.00	0% 0.00	0% 0.00	0% 0.00	
Post-event Tagging Flag:		NO	NO	YES	NO	
Unsafe Placard Trigger (Median, Dispersion)		0% 0.00	0% 0.00	20% 0.50	0% 0.00	
Comments:		Note: DS4 is a copy of DS2 to create a mutually exclusive compliment to DS3.				
Date Created:		Not Given				Root Cost Multiplier: 1
Approved (YES / NO)?		By User				Date Generated: 02/26/19
Official (YES / NO) ?		By User				
Author:		Laura Lowes				
Revisions:		2011-08-24 Changed DS4 beta from 0.4 to 0.3 to avoid negative probability.				

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.021b

NISTIR Name

ACI 318 IMF, Conc Col & Bm = 24" x 24", Beam both sides

Description

ACI318 IMF, joint shear damage or failure, beam or column flexure-shear response. Meets the following requirements: (1) Column Pu < 0.3Agf'c Costing is on a per joint basis.

Line 115

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding Round Qty? YES

Allow sum by floor or building? NO

Demand Location (floor above?) No

Number of Damage States:

4

Damage State:

DS1

DS2

DS3

DS4

Type of Damage State:

Sequential

Sequential

Mutually Exclusive

Mutually Exclusive

DS Hierarchy

Seq(DS1,DS2,MutEx(DS3,DS4))

Descriptions

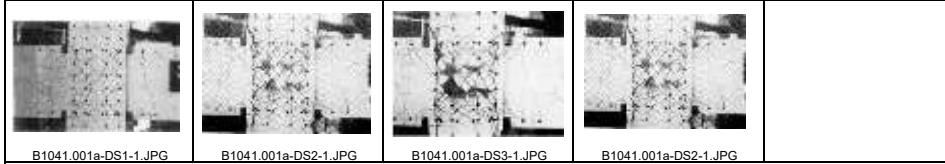
Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.

Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.

Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

Illustrations



Damage State Probability:

1.00

1.00

0.40

0.60

Fragility Parameters

Median Demand, θ :

0.02

0.025

0.035

0.035

Data dispersion, β_d :

0.06

0.30

0.2

0.3

Uncertainty, β_u :

0.4

0.1

0.1

0.1

Total Dispersion, β :

0.4

0.3

0.3

0.3

Correlation (Yes / No)

NO

Data Quality Average

Documentation Quality Superior

Directionality (Yes / No)

YES

Data Relevance Average

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.85E+04	3.25E+04	4.44E+04	2.30E+04	4.00E+04	5.29E+04	1.85E+04	3.25E+04	4.44E+04			
Best fit mean:	2.09E+04 Normal			3.18E+04 Normal			3.86E+04 Normal			3.18E+04 Normal					
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 1.71E+04			3.90E+04 2.60E+04			4.80E+04 3.20E+04			3.90E+04 2.60E+04					
CV or beta (Min Qty, Max Qty)	0.39 0.39			0.32 0.32			0.30 0.30			0.32 0.32					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.63E+01	2.87E+01	3.92E+01	2.03E+01	3.53E+01	4.67E+01	1.63E+01	2.87E+01	3.92E+01			
Best fit mean:	1.89E+01 Normal			2.87E+01 Normal			3.53E+01 Normal			2.87E+01 Normal					
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.27E+01 1.51E+01			3.44E+01 2.29E+01			4.23E+01 2.82E+01			3.44E+01 2.29E+01					
CV or beta (Min Qty, Max Qty)	0.46 0.46			0.40 0.40			0.39 0.39			0.40 0.40					
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	4.9E+03	Normal	0.46	7.8E+03	Normal	0.40	9.4E+03	Normal	0.39	7.8E+03	Normal	0.40			
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.1E+05	Normal	0.40	1.6E+05	Normal	0.39	1.1E+05	Normal	0.40			
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			NO			YES			NO					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			20% 0.50			0% 0.00					

Comments:

Note: DS4 is a copy of DS2 to create a mutually exclusive compliment to DS3.

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:





Laura Lowes

Revisions:





2011-08-24 Changed DS4 beta from 0.4 to 0.3 to avoid negative probability.

Root Cost Multiplier: 1
Date Generated: 02/26/19





FEMA P-58 Fragility Specification

NISTIR Classification		B1041.022a				Line 116					
NISTIR Name		ACI 318 IMF, Conc Col & Bm = 24" x 36", Beam one side									
Description		ACI318 IMF, joint shear damage or failure, beam or column flexure-shear response. Meets the following requirements: (1) Column Pu < 0.3Agf'c. Costing is on a per joint basis.									
Construction Quality:		Not Specified									
Seismic Installation Conditions:		Not Specified									
Fragility Unit of Measure:		EA 1				Quantity Rounding Round Qty? YES					
Demand Parameter (unit):		Story Drift Ratio				Allow sum by floor or building? NO					
Number of Damage States:		4				Demand Location (floor above?) No					
Damage State:		DS1		DS2		DS3		DS4			
Type of Damage State:		Sequential		Sequential		Mutually Exclusive		Mutually Exclusive			
DS Hierarchy		Seq(DS1,DS2,MutEx(DS3,DS4))									
Descriptions		Seq(DS1,DS2,MutEx(DS3,DS4)) Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.		Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.		Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.		Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.			
Illustrations											
Damage State Probability:		1.00		1.00		0.40		0.60			
Fragility Parameters											
Median Demand, θ :		0.02		0.025		0.035		0.035			
Data dispersion, β_d :		0.06		0.30		0.2		0.3			
Uncertainty, β_u :		0.4		0.1		0.1		0.1			
Total Dispersion, β :		0.4		0.3		0.3		0.3			
Correlation (Yes / No)		NO		Data Quality Average		Average		Documentation Quality Superior			
Directionality (Yes / No)		YES		Data Relevance Average		Average		Rationality Superior			
Consequence Functions											
Repair Description		Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.		Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).		Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).		Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).			
Long Lead Time (Yes / No)		NO		NO		NO		NO			
Repair Costs:		P_{10} P_{50} P_{90}		P_{10} P_{50} P_{90}		P_{10} P_{50} P_{90}		P_{10} P_{50} P_{90}		P_{10} P_{50} P_{90}	
Repair Cost by Damage State:		1.02E+04 2.14E+04 3.11E+04		1.95E+04 3.45E+04 4.54E+04		2.40E+04 4.10E+04 5.39E+04		1.95E+04 3.45E+04 4.54E+04			
Best fit mean:		2.09E+04		3.31E+04		3.96E+04		3.31E+04			
Best Fit Distribution:		Normal		Normal		Normal		Normal			
Quantity Plateau (Min Qty, Max Qty)		5.00 20.00		5.00 20.00		5.00 20.00		5.00 20.00			
Average Repair Cost (Min Qty, Max Qty)		2.57E+04 1.71E+04		4.14E+04 2.76E+04		4.92E+04 3.28E+04		4.14E+04 2.76E+04			
CV or beta (Min Qty, Max Qty)		0.39 0.39		0.31 0.31		0.29 0.29		0.31 0.31			
Quantity Unit:		Each		Each		Each		Each			
Repair Time:		P_{10} P_{50} P_{90}		P_{10} P_{50} P_{90}		P_{10} P_{50} P_{90}		P_{10} P_{50} P_{90}		P_{10} P_{50} P_{90}	
Repair Time by Damage State:		8.98E+00 1.89E+01 2.75E+01		1.72E+01 3.04E+01 4.01E+01		2.12E+01 3.62E+01 4.76E+01		1.72E+01 3.04E+01 4.01E+01			
Best fit mean:		1.89E+01		3.04E+01		3.62E+01		3.04E+01			
Best Fit Distribution:		Normal		Normal		Normal		Normal			
Quantity Plateau (Min Qty, Max Qty)		5.00 20.00		5.00 20.00		5.00 20.00		5.00 20.00			
Average Repair Time (Min Qty, Max Qty)		2.27E+01 1.51E+01		3.65E+01 2.43E+01		4.34E+01 2.89E+01		3.65E+01 2.43E+01			
CV or beta (Min Qty, Max Qty)		0.46 0.46		0.39 0.39		0.39 0.39		0.39 0.39			
Quantity Unit:		Each		Each		Each		Each			
Environmental Impacts:		Median Cost Best Fit CV or Beta		Median Cost Best Fit CV or Beta		Median Cost Best Fit CV or Beta		Median Cost Best Fit CV or Beta		Median Cost Best Fit CV or Beta	
Embodied Carbon (kg CO2eq)		4.9E+03 Normal 0.46		8.3E+03 Normal 0.39		9.6E+03 Normal 0.39		8.3E+03 Normal 0.39			
Embodied Energy (MJ)		7.3E+04 Normal 0.46		1.2E+05 Normal 0.39		1.7E+05 Normal 0.39		1.2E+05 Normal 0.39			
LifeSafety Hazard:											
Potential non-collapse casualties? (Yes / No)		NO		NO		NO		NO			
Casualty-affected Planar Area (sf) per Normative Unit:		Not Applicable		Not Applicable		Not Applicable		Not Applicable			
Serious Injury (Median, Dispersion)		0% 0.00		0% 0.00		0% 0.00		0% 0.00			
Loss of Life (Median, Dispersion)		0% 0.00		0% 0.00		0% 0.00		0% 0.00			
Post-event Tagging Flag:		NO		NO		YES		NO			
Unsafe Placard Trigger (Median, Dispersion)		0% 0.00		0% 0.00		20% 0.50		0% 0.00			
Comments:		Note: DS4 is a copy of DS2 to create a mutually exclusive complement to DS3.									
Date Created:		Not Given									
Approved (YES / NO)?		By User									
Official (YES / NO) ?		By User									
Author:		Laura Lowes									
Revisions:		2011-08-24 Changed DS4 beta from 0.4 to 0.3 to avoid negative probability.									
						Root Cost Multiplier:				1	
						Date Generated:				02/26/19	




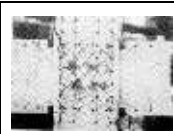
FEMA P-58 Fragility Specification

NISTIR Classification		B1041.022b				Line 117			
NISTIR Name		ACI 318 IMF, Conc Col & Bm = 24" x 36", Beam both sides							
Description		ACI318 IMF, joint shear damage or failure, beam or column flexure-shear response. Meets the following requirements: (1) Column Pu < 0.3Agf'c Costing is on a per joint basis.							
Construction Quality:		Not Specified							
Seismic Installation Conditions:		Not Specified							
Fragility Unit of Measure:		EA 1				Quantity Rounding Round Qty? YES			
Demand Parameter (unit):		Story Drift Ratio				Allow sum by floor or building? NO			
Number of Damage States:		4				Demand Location (floor above?) No			
Damage State:		DS1		DS2		DS3		DS4	
Type of Damage State:		Sequential		Sequential		Mutually Exclusive		Mutually Exclusive	
DS Hierarchy		Seq(DS1.DS2.MutEx(DS3.DS4))							
Descriptions		Seq(DS1.DS2.MutEx(DS3.DS4)) Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.		Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.		Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.		Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	
Illustrations									
Damage State Probability:		1.00		1.00		0.40		0.60	
Fragility Parameters									
Median Demand, θ:		0.02		0.025		0.035		0.035	
Data dispersion, βd:		0.06		0.30		0.2		0.3	
Uncertainty, βu:		0.4		0.1		0.1		0.1	
Total Dispersion, βt:		0.4		0.3		0.3		0.3	
Correlation (Yes / No)		NO		Data Quality Average		Documentation Quality Superior		Rationality Superior	
Directionality (Yes / No)		YES		Data Relevance Average		Rationality Superior			
Consequence Functions									
Repair Description		Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.		Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).		Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).		Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	
Long Lead Time (Yes / No)		NO		NO		NO		NO	
Repair Costs:		P10 P50 P90		P10 P50 P90		P10 P50 P90		P10 P50 P90	
Repair Cost by Damage State:		1.02E+04 2.14E+04 3.11E+04		1.95E+04 3.45E+04 4.54E+04		2.40E+04 4.10E+04 5.39E+04		1.95E+04 3.45E+04 4.54E+04	
Best fit mean:		2.09E+04		3.31E+04		3.96E+04		3.31E+04	
Best Fit Distribution:		Normal		Normal		Normal		Normal	
Quantity Plateau (Min Qty, Max Qty)		5.00 20.00		5.00 20.00		5.00 20.00		5.00 20.00	
Average Repair Cost (Min Qty, Max Qty)		2.57E+04 1.71E+04		4.14E+04 2.76E+04		4.92E+04 3.28E+04		4.14E+04 2.76E+04	
CV or beta (Min Qty, Max Qty)		0.39 0.39		0.31 0.31		0.29 0.29		0.31 0.31	
Quantity Unit:		Each		Each		Each		Each	
Repair Time:		P10 P50 P90		P10 P50 P90		P10 P50 P90		P10 P50 P90	
Repair Time by Damage State:		8.98E+00 1.89E+01 2.75E+01		1.72E+01 3.04E+01 4.01E+01		2.12E+01 3.62E+01 4.76E+01		1.72E+01 3.04E+01 4.01E+01	
Best fit mean:		1.89E+01		3.04E+01		3.62E+01		3.04E+01	
Best Fit Distribution:		Normal		Normal		Normal		Normal	
Quantity Plateau (Min Qty, Max Qty)		5.00 20.00		5.00 20.00		5.00 20.00		5.00 20.00	
Average Repair Time (Min Qty, Max Qty)		2.27E+01 1.51E+01		3.65E+01 2.43E+01		4.34E+01 2.89E+01		3.65E+01 2.43E+01	
CV or beta (Min Qty, Max Qty)		0.46 0.46		0.39 0.39		0.39 0.39		0.39 0.39	
Quantity Unit:		Each		Each		Each		Each	
Environmental Impacts:		Median Cost Best Fit CV or Beta		Median Cost Best Fit CV or Beta		Median Cost Best Fit CV or Beta		Median Cost Best Fit CV or Beta	
Embodied Carbon (kg CO2eq)		4.9E+03 Normal 0.46		8.3E+03 Normal 0.39		9.6E+03 Normal 0.39		8.3E+03 Normal 0.39	
Embodied Energy (MJ)		7.3E+04 Normal 0.46		1.2E+05 Normal 0.39		1.7E+05 Normal 0.39		1.2E+05 Normal 0.39	
LifeSafety Hazard:									
Potential non-collapse casualties? (Yes / No)		NO		NO		NO		NO	
Casualty-affected Planar Area (sf) per Normative Unit:		Not Applicable		Not Applicable		Not Applicable		Not Applicable	
Serious Injury (Median, Dispersion)		0% 0.00		0% 0.00		0% 0.00		0% 0.00	
Loss of Life (Median, Dispersion)		0% 0.00		0% 0.00		0% 0.00		0% 0.00	
Post-event Tagging Flag:		NO		NO		YES		NO	
Unsafe Placard Trigger (Median, Dispersion)		0% 0.00		0% 0.00		20% 0.50		0% 0.00	
Comments:		Note: DS4 is a copy of DS2 to create a mutually exclusive complement to DS3.							
Date Created:		Not Given							
Approved (YES / NO)?		By User							
Official (YES / NO) ?		By User							
Author:		Laura Lowes							
Revisions:		2011-08-24 Changed DS4 beta from 0.4 to 0.3 to avoid negative probability.							
Root Cost Multiplier:		1							
Date Generated:		02/26/19							

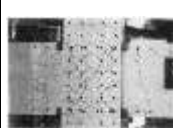


FEMA P-58 Fragility Specification

NISTIR Classification		B1041.023a				Line 118
NISTIR Name		ACI 318 IMF, Conc Col & Bm = 36" x 36", Beam one side				
Description		ACI318 IMF, joint shear damage or failure, beam or column flexure-shear response. Meets the following requirements: (1) Column Pu < 0.3Agf'c. Costing is on a per joint basis.				
Construction Quality:		Not Specified				
Seismic Installation Conditions:		Not Specified				
Fragility Unit of Measure:		EA 1				Quantity Rounding Round Qty? YES
Demand Parameter (unit):		Story Drift Ratio				Allow sum by floor or building? NO
Number of Damage States:		4				Demand Location (floor above?) No
Damage State:		DS1	DS2	DS3	DS4	
Type of Damage State:		Sequential	Sequential	Mutually Exclusive	Mutually Exclusive	
DS Hierarchy		Seq(DS1,DS2,MutEx(DS3,DS4))				
Descriptions		Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	
Illustrations						
Damage State Probability:		1.00	1.00	0.40	0.60	
Fragility Parameters						
Median Demand, θ:		0.02	0.025	0.035	0.035	
Data dispersion, β_d:		0.06	0.30	0.2	0.3	
Uncertainty, β_u:		0.4	0.1	0.1	0.1	
Total Dispersion, β:		0.4	0.3	0.3	0.3	
Correlation (Yes / No)		NO	Data Quality Average		Documentation Quality Superior	
Directionality (Yes / No)		YES	Data Relevance Average		Rationality Superior	
Consequence Functions						
Repair Description		Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	
Long Lead Time (Yes / No)		NO	NO	NO	NO	
Repair Costs:		P₁₀ P₅₀ P₉₀	P₁₀ P₅₀ P₉₀	P₁₀ P₅₀ P₉₀	P₁₀ P₅₀ P₉₀	P₁₀ P₅₀ P₉₀
Repair Cost by Damage State:		1.02E+04 2.14E+04 3.11E+04	1.95E+04 3.45E+04 4.54E+04	2.40E+04 4.10E+04 5.39E+04	1.95E+04 3.45E+04 4.54E+04	
Best fit mean:		2.09E+04	3.31E+04	3.96E+04	3.31E+04	
Best Fit Distribution:		Normal	Normal	Normal	Normal	
Quantity Plateau (Min Qty, Max Qty)		5.00 20.00	5.00 20.00	5.00 20.00	5.00 20.00	
Average Repair Cost (Min Qty, Max Qty)		2.57E+04 1.71E+04	4.14E+04 2.76E+04	4.92E+04 3.28E+04	4.14E+04 2.76E+04	
CV or beta (Min Qty, Max Qty)		0.39 0.39	0.31 0.31	0.29 0.29	0.31 0.31	
Quantity Unit:		Each	Each	Each	Each	
Repair Time:		P₁₀ P₅₀ P₉₀	P₁₀ P₅₀ P₉₀	P₁₀ P₅₀ P₉₀	P₁₀ P₅₀ P₉₀	P₁₀ P₅₀ P₉₀
Repair Time by Damage State:		8.98E+00 1.89E+01 2.75E+01	1.72E+01 3.04E+01 4.01E+01	2.12E+01 3.62E+01 4.76E+01	1.72E+01 3.04E+01 4.01E+01	
Best fit mean:		1.89E+01	3.04E+01	3.62E+01	3.04E+01	
Best Fit Distribution:		Normal	Normal	Normal	Normal	
Quantity Plateau (Min Qty, Max Qty)		5.00 20.00	5.00 20.00	5.00 20.00	5.00 20.00	
Average Repair Time (Min Qty, Max Qty)		2.27E+01 1.51E+01	3.65E+01 2.43E+01	4.34E+01 2.89E+01	3.65E+01 2.43E+01	
CV or beta (Min Qty, Max Qty)		0.46 0.46	0.39 0.39	0.39 0.39	0.39 0.39	
Quantity Unit:		Each	Each	Each	Each	
Environmental Impacts:		Median Cost Best Fit CV or Beta	Median Cost Best Fit CV or Beta	Median Cost Best Fit CV or Beta	Median Cost Best Fit CV or Beta	Median Cost Best Fit CV or Beta
Embodied Carbon (kg CO2eq)		4.9E+03 Normal 0.46	8.3E+03 Normal 0.39	9.6E+03 Normal 0.39	8.3E+03 Normal 0.39	
Embodied Energy (MJ)		7.3E+04 Normal 0.46	1.2E+05 Normal 0.39	1.7E+05 Normal 0.39	1.2E+05 Normal 0.39	
LifeSafety Hazard:						
Potential non-collapse casualties? (Yes / No)		NO	NO	NO	NO	
Casualty-affected Planar Area (sf) per Normative Unit:		Not Applicable	Not Applicable	Not Applicable	Not Applicable	
Serious Injury (Median, Dispersion)		0% 0.00	0% 0.00	0% 0.00	0% 0.00	
Loss of Life (Median, Dispersion)		0% 0.00	0% 0.00	0% 0.00	0% 0.00	
Post-event Tagging Flag:		NO	NO	YES	NO	
Unsafe Placard Trigger (Median, Dispersion)		0% 0.00	0% 0.00	20% 0.50	0% 0.00	
Comments:		Note: DS4 is a copy of DS2 to create a mutually exclusive compliment to DS3.				
Date Created:		Not Given				Root Cost Multiplier: 1
Approved (YES / NO)?		By User				Date Generated: 02/26/19
Official (YES / NO) ?		By User				
Author:		Laura Lowes				
Revisions:		2011-08-24 Changed DS4 beta from 0.4 to 0.3 to avoid negative probability.				

FEMA P-58 Fragility Specification

NISTIR Classification		B1041.023b				Line 119					
NISTIR Name		ACI 318 IMF, Conc Col & Bm = 36" x 36", Beam both sides									
Description		ACI318 IMF, joint shear damage or failure, beam or column flexure-shear response. Meets the following requirements: (1) Column Pu < 0.3Agf'c Costing is on a per joint basis.									
Construction Quality:		Not Specified									
Seismic Installation Conditions:		Not Specified									
Fragility Unit of Measure:		EA 1				Quantity Rounding Round Qty? YES					
Demand Parameter (unit):		Story Drift Ratio				Allow sum by floor or building? NO					
Number of Damage States:		4				Demand Location (floor above?) No					
Damage State:		DS1		DS2		DS3		DS4			
Type of Damage State:		Sequential		Sequential		Mutually Exclusive		Mutually Exclusive			
DS Hierarchy		Seq(DS1.DS2.MutEx(DS3.DS4))									
Descriptions		Seq(DS1.DS2.MutEx(DS3.DS4)) Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.		Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.		Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.		Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.			
Illustrations											
Damage State Probability:		1.00		1.00		0.40		0.60			
Fragility Parameters											
Median Demand, θ:		0.02		0.025		0.035		0.035			
Data dispersion, βd:		0.06		0.30		0.2		0.3			
Uncertainty, βu:		0.4		0.1		0.1		0.1			
Total Dispersion, β:		0.4		0.3		0.3		0.3			
Correlation (Yes / No)		NO		Data Quality Average		Average		Documentation Quality Superior			
Directionality (Yes / No)		YES		Data Relevance Average		Average		Rationality Superior			
Consequence Functions											
Repair Description		Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.		Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).		Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).		Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).			
Long Lead Time (Yes / No)		NO		NO		NO		NO			
Repair Costs:		P10 P50 P90		P10 P50 P90		P10 P50 P90		P10 P50 P90		P10 P50 P90	
Repair Cost by Damage State:		1.02E+04 2.14E+04 3.11E+04		1.95E+04 3.45E+04 4.54E+04		2.40E+04 4.10E+04 5.39E+04		1.95E+04 3.45E+04 4.54E+04			
Best fit mean:		2.09E+04		3.31E+04		3.96E+04		3.31E+04			
Best Fit Distribution:		Normal		Normal		Normal		Normal			
Quantity Plateau (Min Qty, Max Qty)		5.00 20.00		5.00 20.00		5.00 20.00		5.00 20.00			
Average Repair Cost (Min Qty, Max Qty)		2.57E+04 1.71E+04		4.14E+04 2.76E+04		4.92E+04 3.28E+04		4.14E+04 2.76E+04			
CV or beta (Min Qty, Max Qty)		0.39 0.39		0.31 0.31		0.29 0.29		0.31 0.31			
Quantity Unit:		Each		Each		Each		Each			
Repair Time:		P10 P50 P90		P10 P50 P90		P10 P50 P90		P10 P50 P90		P10 P50 P90	
Repair Time by Damage State:		8.98E+00 1.89E+01 2.75E+01		1.72E+01 3.04E+01 4.01E+01		2.12E+01 3.62E+01 4.76E+01		1.72E+01 3.04E+01 4.01E+01			
Best fit mean:		1.89E+01		3.04E+01		3.62E+01		3.04E+01			
Best Fit Distribution:		Normal		Normal		Normal		Normal			
Quantity Plateau (Min Qty, Max Qty)		5.00 20.00		5.00 20.00		5.00 20.00		5.00 20.00			
Average Repair Time (Min Qty, Max Qty)		2.27E+01 1.51E+01		3.65E+01 2.43E+01		4.34E+01 2.89E+01		3.65E+01 2.43E+01			
CV or beta (Min Qty, Max Qty)		0.46 0.46		0.39 0.39		0.39 0.39		0.39 0.39			
Quantity Unit:		Each		Each		Each		Each			
Environmental Impacts:		Median Cost Best Fit CV or Beta		Median Cost Best Fit CV or Beta		Median Cost Best Fit CV or Beta		Median Cost Best Fit CV or Beta		Median Cost Best Fit CV or Beta	
Embodied Carbon (kg CO2eq)		4.9E+03 Normal 0.46		8.3E+03 Normal 0.39		9.6E+03 Normal 0.39		8.3E+03 Normal 0.39			
Embodied Energy (MJ)		7.3E+04 Normal 0.46		1.2E+05 Normal 0.39		1.7E+05 Normal 0.39		1.2E+05 Normal 0.39			
LifeSafety Hazard:											
Potential non-collapse casualties? (Yes / No)		NO		NO		NO		NO			
Casualty-affected Planar Area (sf) per Normative Unit:		Not Applicable		Not Applicable		Not Applicable		Not Applicable			
Serious Injury (Median, Dispersion)		0% 0.00		0% 0.00		0% 0.00		0% 0.00			
Loss of Life (Median, Dispersion)		0% 0.00		0% 0.00		0% 0.00		0% 0.00			
Post-event Tagging Flag:		NO		NO		YES		NO			
Unsafe Placard Trigger (Median, Dispersion)		0% 0.00		0% 0.00		20% 0.50		0% 0.00			
Comments:		Note: DS4 is a copy of DS2 to create a mutually exclusive complement to DS3.									
Date Created:		Not Given									
Approved (YES / NO)?		By User									
Official (YES / NO) ?		By User									
Author:		Laura Lowes									
Revisions:		2011-08-24 Changed DS4 beta from 0.4 to 0.3 to avoid negative probability.									
						Root Cost Multiplier:				1	
						Date Generated:				02/26/19	

FEMA P-58 Fragility Specification

NISTIR Classification		B1041.031a		Line 120	
NISTIR Name		ACI 318 OMF with weak joints and beam flexural response, Conc Col & Bm = 24" x 24", Beam one side			
Description		ACI318 OMF, joint shear failure, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) Beam Vn > Veq, (3) Column Vn > Veq. Costing is on a per joint basis.			
Construction Quality:		Not Specified			
Seismic Installation Conditions:		Not Specified			
Fragility Unit of Measure:		EA 1		Quantity Rounding Round Qty? YES	
Demand Parameter (unit):		Story Drift Ratio		Allow sum by floor or building? NO	
Number of Damage States:		3		Demand Location (floor above?) No	
Damage State:		DS1		DS2	
Type of Damage State:		Sequential		Sequential	
DS Hierarchy		Seq(DS1,DS2,DS3)		Sequential	
Descriptions		Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.		Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	
				Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.	
Illustrations					
		B1041.031a-DS1-1.JPG		B1041.031a-DS2-1.JPG	
					
				B1041.031a-DS3-1.JPG	
Damage State Probability:		1.00		1.00	
Fragility Parameters					
Median Demand, θ :		0.0175		0.0225	
Data dispersion, β_d :		0.2		0.27	
Uncertainty, β_u :		0.3		0.13	
Total Dispersion, β :		0.4		0.4	
Correlation (Yes / No)		NO		Data Quality Average	
Directionality (Yes / No)		YES		Documentation Quality Superior	
				Rationality Superior	
Consequence Functions					
Repair Description		Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.		Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	
				Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	
Long Lead Time (Yes / No)		NO		NO	
Repair Costs:		P_{10} P_{50} P_{90}		P_{10} P_{50} P_{90}	
Repair Cost by Damage State:		1.02E+04 2.14E+04 3.11E+04		1.85E+04 3.25E+04 4.44E+04	
Best fit mean:		2.09E+04		3.18E+04	
Best Fit Distribution:		Normal		Normal	
Quantity Plateau (Min Qty, Max Qty)		5.00 20.00		5.00 20.00	
Average Repair Cost (Min Qty, Max Qty)		2.57E+04 1.71E+04		3.90E+04 2.60E+04	
CV or beta (Min Qty, Max Qty)		0.39 0.39		0.32 0.32	
Quantity Unit:		Each		Each	
Repair Time:		P_{10} P_{50} P_{90}		P_{10} P_{50} P_{90}	
Repair Time by Damage State:		8.98E+00 1.89E+01 2.75E+01		1.63E+01 2.87E+01 3.92E+01	
Best fit mean:		1.89E+01		2.87E+01	
Best Fit Distribution:		Normal		Normal	
Quantity Plateau (Min Qty, Max Qty)		5.00 20.00		5.00 20.00	
Average Repair Time (Min Qty, Max Qty)		2.27E+01 1.51E+01		3.44E+01 2.29E+01	
CV or beta (Min Qty, Max Qty)		0.46 0.46		0.40 0.40	
Quantity Unit:		Each		Each	
Environmental Impacts:		Median Cost Best Fit CV or Beta		Median Cost Best Fit CV or Beta	
Embodied Carbon (kg CO2eq)		4.9E+03 Normal 0.46		7.8E+03 Normal 0.40	
Embodied Energy (MJ)		7.3E+04 Normal 0.46		1.1E+05 Normal 0.40	
LifeSafety Hazard:					
Potential non-collapse casualties? (Yes / No)		NO		NO	
Casualty-affected Planar Area (sf) per Normative Unit:		Not Applicable		Not Applicable	
Serious Injury (Median, Dispersion)		0% 0.00		0% 0.00	
Loss of Life (Median, Dispersion)		0% 0.00		0% 0.00	
Post-event Tagging Flag:		NO		YES	
Unsafe Placard Trigger (Median, Dispersion)		0% 0.00		20% 0.50	
Comments:		None			
Date Created:		Not Given			
Approved (YES / NO)?		By User			
Official (YES / NO) ?		By User			
Author:		Laura Lowes			
Revisions:		2011-08-24 Changed DS2 beta from 0.3 to 0.4 to avoid negative probability beyond 1% story drift.			
		Root Cost Multiplier: 1			
		Date Generated: 02/26/19			

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.031b

NISTIR Name

ACI 318 OMF with weak joints and beam flexural response, Conc Col & Bm = 24" x 24", Beam both sides

Description

ACI318 OMF, joint shear failure, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) Beam Vn > Veq, (3) Column Vn > Veq. Costing is on a per joint basis.

Line 121

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

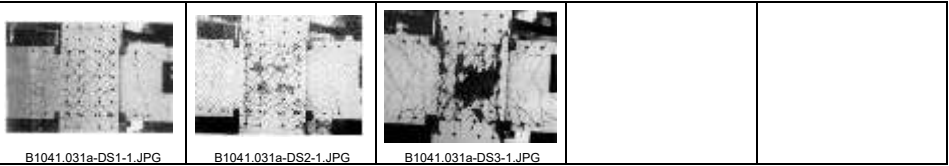
Descriptions

Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.

Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.

Illustrations



Damage State Probability:

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.0175

0.0225

0.0322

Data dispersion, β_d :

0.2

0.27

0.32

Uncertainty, β_u :

0.3

0.13

0.15

Total Dispersion, β :

0.4

0.4

0.4

Correlation (Yes / No)

NO

Data Quality Average

Documentation Quality Superior

Directionality (Yes / No)

YES

Data Relevance Average

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.85E+04	3.25E+04	4.44E+04	2.30E+04	4.00E+04	5.29E+04						
Best fit mean:	2.09E+04			3.18E+04			3.86E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 0.39 0.39			3.90E+04 0.32 0.32			4.80E+04 0.30 0.30								
CV or beta (Min Qty, Max Qty)	Each			Each			Each								
Quantity Unit:															
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.63E+01	2.87E+01	3.92E+01	2.03E+01	3.53E+01	4.67E+01						
Best fit mean:	1.89E+01			2.87E+01			3.53E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	2.27E+01 0.46 0.46			3.44E+01 0.40 0.40			4.23E+01 0.39 0.39								
CV or beta (Min Qty, Max Qty)	Each			Each			Each								
Quantity Unit:															
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	7.8E+03	Normal	0.40	9.4E+03	Normal	0.39						
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.1E+05	Normal	0.40	1.6E+05	Normal	0.39						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			20% 0.50								

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Laura Lowes

Revisions:

2011-08-24 Changed DS2 beta from 0.3 to 0.4 to avoid negative probability beyond 1% story drift.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1041.032a

ACI 318 OMF with weak joints and beam flexural response, Conc Col & Bm = 24" x 36", Beam one side

ACI318 OMF, joint shear failure, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) Beam Vn > Veq, (3) Column Vn > Veq. Costing is on a per joint basis.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

EA 1

Story Drift Ratio

3

DS1

Sequential

Seq(DS1,DS2,DS3)

Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.

DS2

Sequential

Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

DS3

Sequential

Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.

Quantity Rounding

Round Qty?

YES

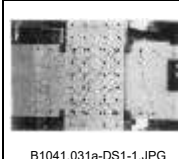
Allow sum by floor or building?

NO


Demand Location (floor above?)

No

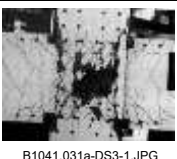
Illustrations



B1041.031a-DS1-1.JPG



B1041.031a-DS2-1.JPG



B1041.031a-DS3-1.JPG

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.00

1.00

1.00

0.0175

0.2

0.3

0.4

0.0225

0.27

0.13

0.4

0.0322

0.32

0.15

0.4

NO

YES

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.02E+04

2.14E+04

3.11E+04

Normal

5.00

20.00

2.57E+04

0.39

Each

P₁₀

P₅₀

P₉₀

1.95E+04

3.45E+04

4.54E+04

Normal

5.00

20.00

4.14E+04

0.31

Each

P₁₀

P₅₀

P₉₀

2.40E+04

4.10E+04

5.39E+04

Normal

5.00

20.00

4.92E+04

0.29

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

8.98E+00

1.89E+01

2.75E+01

Normal

5.00

20.00

2.27E+01

0.46

Each

P₁₀

P₅₀

P₉₀

1.72E+01

3.04E+01

4.01E+01

Normal

5.00

20.00

3.65E+01

0.39

Each

P₁₀

P₅₀

P₉₀

2.12E+01

3.62E+01

4.76E+01

Normal

5.00

20.00

4.34E+01

0.39

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

4.9E+03

Normal

0.46

Median Cost

Best Fit

CV or Beta

8.3E+03

Normal

0.39

Median Cost

Best Fit

CV or Beta

9.6E+03

Normal

0.39

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

YES

20%

0.50

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Laura Lowes

2011-08-24 Changed DS2 beta from 0.3 to 0.4 to avoid negative probability beyond 1% story drift.

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.032b

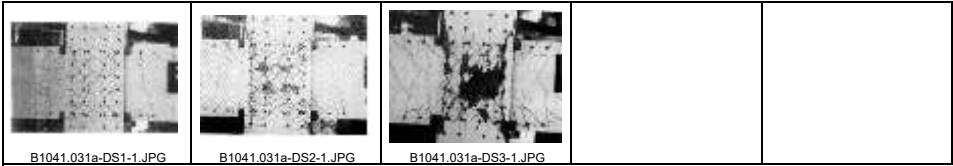
NISTIR Name
Description

ACI 318 OMF with weak joints and beam flexural response, Conc Col & Bm = 24" x 36", Beam both sides
ACI318 OMF, joint shear failure, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) Beam Vn > Veq, (3) Column Vn > Veq. Costing is on a per joint basis.

Line 123

Construction Quality:	Not Specified					<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	EA 1					
Demand Parameter (unit):	Story Drift RatioUnit less					
Number of Damage States:	3					
Damage State:	DS1	DS2	DS3			
Type of Damage State:	Sequential	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2,DS3)					
Descriptions	Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.			

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, δ :	0.0175	0.0225	0.0322		
Data dispersion, β_d :	0.2	0.27	0.32		
Uncertainty, β_u :	0.3	0.13	0.15		
Total Dispersion, β :	0.4	0.4	0.4		
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Superior	

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 1.71E+04			4.14E+04 2.76E+04			4.92E+04 3.28E+04								
CV or beta (Min Qty, Max Qty)	0.39 0.39			0.31 0.31			0.29 0.29								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	2.27E+01 1.51E+01			3.65E+01 2.43E+01			4.34E+01 2.89E+01								
CV or beta (Min Qty, Max Qty)	0.46 0.46			0.39 0.39			0.39 0.39								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	8.3E+03	Normal	0.39	9.6E+03	Normal	0.39						
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.2E+05	Normal	0.39	1.7E+05	Normal	0.39						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		20%	0.50							

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: 2011-08-24 Changed DS2 beta from 0.3 to 0.4 to avoid negative probability beyond 1% story drift.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1041.033a

ACI 318 OMF with weak joints and beam flexural response, Conc Col & Bm = 36" x 36", Beam one side

ACI318 OMF, joint shear failure, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) Beam Vn > Veq, (3) Column Vn > Veq. Costing is on a per joint basis.

Line 124

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

EA 1

Story Drift Ratio

3

DS1

Sequential

Seq(DS1,DS2,DS3)

Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.

DS2

Sequential

Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

DS3

Sequential

Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.

Quantity Rounding

Round Qty?

YES

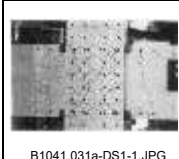
Allow sum by floor or building?


NO

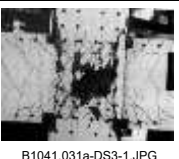
Demand Location (floor above?)

No

Illustrations







B1041.031a-DS1-1.JPG

B1041.031a-DS2-1.JPG

B1041.031a-DS3-1.JPG

1.00

1.00

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

NO

YES

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.02E+04

2.14E+04

3.11E+04

1.95E+04

3.45E+04

4.54E+04

2.40E+04

4.10E+04

5.39E+04

P₁₀

P₅₀

P₉₀

2.09E+04

Normal

5.00

20.00

5.00

20.00

5.00

20.00

2.57E+04

1.71E+04

4.14E+04

2.76E+04

4.92E+04

3.28E+04

0.39

0.39

0.31

0.31

0.29

0.29

Each

Each

Each

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

8.98E+00

1.89E+01

2.75E+01

1.72E+01

3.04E+01

4.01E+01

2.12E+01

3.62E+01

4.76E+01

P₁₀

P₅₀

P₉₀

1.89E+01

Normal

5.00

20.00

5.00

20.00

5.00

20.00

2.27E+01

1.51E+01

3.65E+01

2.43E+01

4.34E+01

2.89E+01

0.46

0.46

0.39

0.39

0.39

0.39

Each

Each

Each

Environmental Impacts:

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

4.9E+03

Normal

0.46

8.3E+03

Normal

0.39

9.6E+03

Normal

0.39

7.3E+04

Normal

0.46

1.2E+05

Normal

0.39

1.7E+05

Normal

0.39

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

Not Applicable

0%

0.00

YES

20%

0.50

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Laura Lowes

2011-08-24 Changed DS2 beta from 0.3 to 0.4 to avoid negative probability beyond 1% story drift.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.033b

NISTIR Name

ACI 318 OMF with weak joints and beam flexural response, Conc Col & Bm = 36" x 36", Beam both sides

Description

ACI318 OMF, joint shear failure, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) Beam Vn > Veq, (3) Column Vn > Veq. Costing is on a per joint basis.

Line 125

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

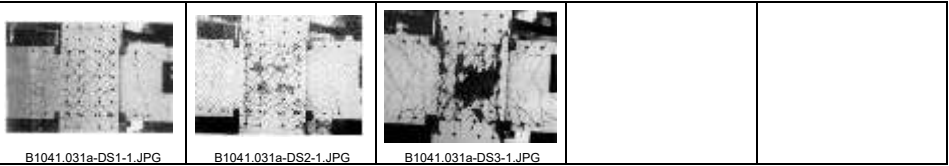
Descriptions

Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.

Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.

Illustrations



Damage State Probability:

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.0175

0.0225

0.0322

Data dispersion, β_d :

0.2

0.27

0.32

Uncertainty, β_u :

0.3

0.13

0.15

Total Dispersion, β :

0.4

0.4

0.4

Correlation (Yes / No)

NO

Data Quality Average

Documentation Quality Superior

Directionality (Yes / No)

YES

Data Relevance Average

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 1.71E+04			4.14E+04 2.76E+04			4.92E+04 3.28E+04								
CV or beta (Min Qty, Max Qty)	0.39 0.39			0.31 0.31			0.29 0.29								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	2.27E+01 1.51E+01			3.65E+01 2.43E+01			4.34E+01 2.89E+01								
CV or beta (Min Qty, Max Qty)	0.46 0.46			0.39 0.39			0.39 0.39								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	8.3E+03	Normal	0.39	9.6E+03	Normal	0.39						
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.2E+05	Normal	0.39	1.7E+05	Normal	0.39						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			20% 0.50								

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Laura Lowes

Revisions:

2011-08-24 Changed DS2 beta from 0.3 to 0.4 to avoid negative probability beyond 1% story drift.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1041.041a

ACI 318 OMF with weak joints and column flexural response, Conc Col & Bm = 24" x 24", Beam one side

ACI318 OMF, joint shear failure, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) Beam Vn > Veq, (3) Column Vn > Veq. Costing is on a per joint basis.

Line 126

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

EA 1

Story Drift Ratio

3

DS1

Sequential

Seq(DS1,DS2,DS3)

Concrete Cracking: beams, joints or possibly Residual concrete crack widths exceed 0.06 in. (1.5 mm). Column exhibit residual crack widths that require epoxy injection.

DS2

Sequential

Concrete Spalling: slabs, beams, joints or possibly columns exhibit spalling of cover concrete that exposes transverse but not longitudinal reinforcing steel. Spalling of cover concrete possibly exposing transverse reinforcement.

DS3

Sequential

Concrete Crushing: slabs, beams or joints. Spalling of beam, column or joint cover concrete exposes longitudinal reinforcement OR strength loss initiates in laboratory testing, exhibit concrete spalling that exposes longitudinal steel or crushing of core concrete.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

none

1.00

none

1.00

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.015

Not Specified

0.4

0.4

NO

YES

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.02E+04

2.14E+04

3.11E+04

Normal

5.00

20.00

2.57E+04

0.39

Each

P₁₀

P₅₀

P₉₀

1.85E+04

3.25E+04

4.44E+04

Normal

5.00

20.00

3.90E+04

0.32

Each

P₁₀

P₅₀

P₉₀

2.30E+04

4.00E+04

5.29E+04

Normal

5.00

20.00

4.80E+04

0.30

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

8.98E+00

1.89E+01

2.75E+01

Normal

5.00

20.00

2.27E+01

0.46

Each

P₁₀

P₅₀

P₉₀

1.63E+01

2.87E+01

3.92E+01

Normal

5.00

20.00

3.44E+01

0.40

Each

P₁₀

P₅₀

P₉₀

2.03E+01

3.53E+01

4.67E+01

Normal

5.00

20.00

4.23E+01

0.39

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

4.9E+03

Normal

0.46

Median Cost

Best Fit

CV or Beta

7.8E+03

Normal

0.40

Median Cost

Best Fit

CV or Beta

9.4E+03

Normal

0.39

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

YES

20%

0.50

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Laura Lowes

2011-08-24 Changed DS2 beta from 0.3 to 0.4 to avoid negative probability beyond 1% story drift.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.041b

NISTIR Name
Description

ACI 318 OMF with weak joints and column flexural response, Conc Col & Bm = 24" x 24", Beam both sides
ACI318 OMF, joint shear failure, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) Beam Vn > Veq, (3) Column Vn > Veq. Costing is on a per joint basis.

Line 127

Construction Quality:	Not Specified					<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	EA 1					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	3					
Damage State:	DS1		DS2		DS3	
Type of Damage State:	Sequential		Sequential		Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)					
Descriptions	Concrete Cracking: beams, joints or possibly Residual concrete crack widths exceed 0.06 in. (1.5 mm). Column exhibit residual crack widths that require epoxy injection.		Concrete Spalling: slabs, beams, joints or possibly columns exhibit spalling of cover concrete that exposes transverse but not longitudinal reinforcing steel. Spalling of cover concrete possibly exposing transverse reinforcement.		Concrete Crushing: slabs, beams or joints. Spalling of beam, column or joint cover concrete exposes longitudinal reinforcement OR strength loss initiates in laboratory testing, exhibit concrete spalling that exposes longitudinal steel or crushing of core concrete.	

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.015	0.0175	0.02		
Data dispersion, β_d :	Not Specified	0.28	0.18		
Uncertainty, β_u :	0.4	0.15	0.35		
Total Dispersion, β :	0.4	0.4	0.4		
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Superior	

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.85E+04	3.25E+04	4.44E+04	2.30E+04	4.00E+04	5.29E+04						
Best fit mean:	2.09E+04			3.18E+04			3.86E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00								
Average Repair Cost (Min Qty, Max Qty)	2.57E+04			3.90E+04			4.80E+04								
CV or beta (Min Qty, Max Qty)	0.39			0.32			0.30								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.63E+01	2.87E+01	3.92E+01	2.03E+01	3.53E+01	4.67E+01						
Best fit mean:	1.89E+01			2.87E+01			3.53E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00								
Average Repair Time (Min Qty, Max Qty)	2.27E+01			3.44E+01			4.23E+01								
CV or beta (Min Qty, Max Qty)	0.46			0.40			0.39								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	7.8E+03	Normal	0.40	9.4E+03	Normal	0.39						
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.1E+05	Normal	0.40	1.6E+05	Normal	0.39						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		20%	0.50							

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: 2011-08-24 Changed DS2 beta from 0.3 to 0.4 to avoid negative probability beyond 1% story drift.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1041.042a

ACI 318 OMF with weak joints and column flexural response, Conc Col & Bm = 24" x 36", Beam one side

ACI318 OMF, joint shear failure, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) Beam Vn > Veq, (3) Column Vn > Veq. Costing is on a per joint basis.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

EA 1

Story Drift Ratio

3

DS1

Sequential

Seq(DS1,DS2,DS3)

Concrete Cracking: beams, joints or possibly Residual concrete crack widths exceed 0.06 in. (1.5 mm). Column exhibit residual crack widths that require epoxy injection.

DS2

Sequential

Concrete Spalling: slabs, beams, joints or possibly columns exhibit spalling of cover concrete that exposes transverse but not longitudinal reinforcing steel. Spalling of cover concrete possibly exposing transverse reinforcement.

DS3

Sequential

Concrete Crushing: slabs, beams or joints. Spalling of beam, column or joint cover concrete exposes longitudinal reinforcement OR strength loss initiates in laboratory testing, exhibit concrete spalling that exposes longitudinal steel or crushing of core concrete.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Data Quality

Average

Documentation Quality

Superior

NO

YES

NO

1.00

0.015

Not Specified

0.4

0.4

NO

NO

Average

Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

1.02E+04

2.14E+04

3.11E+04

P₁₀

P₅₀

P₉₀

1.95E+04

3.45E+04

4.54E+04

P₁₀

P₅₀

P₉₀

2.40E+04

4.10E+04

5.39E+04

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.09E+04

Normal

5.00

20.00

3.31E+04

Normal

5.00

20.00

3.96E+04

Normal

5.00

20.00

2.57E+04

1.71E+04

0.39

0.39

4.14E+04

2.76E+04

0.31

0.31

4.92E+04

3.28E+04

0.29

0.29

Each

Each

Each

8.98E+00

1.89E+01

2.75E+01

5.00

20.00

1.72E+01

3.04E+01

4.01E+01

5.00

20.00

2.12E+01

3.62E+01

4.76E+01

5.00

20.00

2.27E+01

1.51E+01

0.46

0.46

3.65E+01

2.43E+01

0.39

0.39

4.34E+01

2.89E+01

0.39

0.39

Each

Each

Each

Median Cost

Best Fit

CV or Beta

4.9E+03

Normal

0.46

Median Cost

Best Fit

CV or Beta

8.3E+03

Normal

0.39

Median Cost

Best Fit

CV or Beta

9.6E+03

Normal

0.39

7.3E+04

Normal

0.46

1.2E+05

Normal

0.39

1.7E+05

Normal

0.39

NO

NO

NO

Not Applicable

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

0%

0.00

NO

NO

YES

0%

0.00

0%

0.00

20%

0.50

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Laura Lowes

2011-08-24 Changed DS2 beta from 0.3 to 0.4 to avoid negative probability beyond 1% story drift.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.042b

NISTIR Name

ACI 318 OMF with weak joints and column flexural response, Conc Col & Bm = 24" x 36", Beam both sides

Description

ACI318 OMF, joint shear failure, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) Beam Vn > Veq, (3) Column Vn > Veq. Costing is on a per joint basis.

Line 129

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding Round Qty? YES

Allow sum by floor or building? NO

Demand Location (floor above?) No

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

Concrete Cracking: beams, joints or possibly Residual concrete crack widths exceed 0.06 in. (1.5 mm). Column exhibit residual crack widths that require epoxy injection.

Concrete Spalling: slabs, beams, joints or possibly columns exhibit spalling of cover concrete that exposes transverse but not longitudinal reinforcing steel. Spalling of cover concrete possibly exposing transverse reinforcement.

Concrete Crushing: slabs, beams or joints. Spalling of beam, column or joint cover concrete exposes longitudinal reinforcement OR strength loss initiates in laboratory testing, exhibit concrete spalling that exposes longitudinal steel or crushing of core concrete.

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:

Fragility Parameters

Median Demand, θ :

0.015

0.0175

0.02

Data dispersion, β_d :

Not Specified

0.28

0.18

Uncertainty, β_u :

0.4

0.15

0.35

Total Dispersion, β :

0.4

0.4

Correlation (Yes / No)

NO

Directionality (Yes / No)

YES

Data Quality Average

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00			20.00					
Average Repair Cost (Min Qty, Max Qty)	2.57E+04			4.14E+04			4.92E+04			3.28E+04					
CV or beta (Min Qty, Max Qty)	0.39			0.31			0.29			0.29					
Quantity Unit:	Each			Each			Each								
Repair Time:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00			20.00					
Average Repair Time (Min Qty, Max Qty)	2.27E+01			3.65E+01			4.34E+01			2.89E+01					
CV or beta (Min Qty, Max Qty)	0.46			0.39			0.39			0.39					
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	8.3E+03	Normal	0.39	9.6E+03	Normal	0.39						
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.2E+05	Normal	0.39	1.7E+05	Normal	0.39						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%			0%			0%			0%					
Loss of Life (Median, Dispersion)	0%			0%			0%			0%					
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%			0%			20%			0.50					

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Laura Lowes

Revisions:

2011-08-24 Changed DS2 beta from 0.3 to 0.4 to avoid negative probability beyond 1% story drift.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.043a

NISTIR Name
Description

ACI 318 OMF with weak joints and column flexural response, Conc Col & Bm = 36" x 36", Beam one side
ACI318 OMF, joint shear failure, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) Beam Vn > Veq, (3) Column Vn > Veq. Costing is on a per joint basis.

Line 130

Construction Quality:	Not Specified					<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	EA 1					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	3					
Damage State:	DS1		DS2		DS3	
Type of Damage State:	Sequential		Sequential		Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)					
Descriptions	Concrete Cracking: beams, joints or possibly Residual concrete crack widths exceed 0.06 in. (1.5 mm). Column exhibit residual crack widths that require epoxy injection.		Concrete Spalling: slabs, beams, joints or possibly columns exhibit spalling of cover concrete that exposes transverse but not longitudinal reinforcing steel. Spalling of cover concrete possibly exposing transverse reinforcement.		Concrete Crushing: slabs, beams or joints. Spalling of beam, column or joint cover concrete exposes longitudinal reinforcement OR strength loss initiates in laboratory testing, exhibit concrete spalling that exposes longitudinal steel or crushing of core concrete.	

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.015	0.0175	0.02		
Data dispersion, β_d :	Not Specified	0.28	0.18		
Uncertainty, β_u :	0.4	0.15	0.35		
Total Dispersion, β :	0.4	0.4	0.4		
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Superior	

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00								
Average Repair Cost (Min Qty, Max Qty)	2.57E+04			4.14E+04			4.92E+04								
CV or beta (Min Qty, Max Qty)	0.39			0.31			0.29								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00								
Average Repair Time (Min Qty, Max Qty)	2.27E+01			3.65E+01			4.34E+01								
CV or beta (Min Qty, Max Qty)	0.46			0.39			0.39								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	8.3E+03	Normal	0.39	9.6E+03	Normal	0.39						
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.2E+05	Normal	0.39	1.7E+05	Normal	0.39						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		20%	0.50							

Comments:

None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: 2011-08-24 Changed DS2 beta from 0.3 to 0.4 to avoid negative probability beyond 1% story drift.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.043b

NISTIR Name
Description

ACI 318 OMF with weak joints and column flexural response, Conc Col & Bm = 36" x 36", Beam both sides
ACI318 OMF, joint shear failure, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) Beam Vn > Veq, (3) Column Vn > Veq. Costing is on a per joint basis.

Line 131

Construction Quality:	Not Specified				Quantity RoundingRound Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1		DS2	DS3	
Type of Damage State:	Sequential		Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Concrete Cracking: beams, joints or possibly Residual concrete crack widths exceed 0.06 in. (1.5 mm). Column exhibit residual crack widths that require epoxy injection.	Concrete Spalling: slabs, beams, joints or possibly columns exhibit spalling of cover concrete that exposes transverse but not longitudinal reinforcing steel. Spalling of cover concrete possibly exposing transverse reinforcement.	Concrete Crushing: slabs, beams or joints. Spalling of beam, column or joint cover concrete exposes longitudinal reinforcement OR strength loss initiates in laboratory testing, exhibit concrete spalling that exposes longitudinal steel or crushing of core concrete.		
Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.015	0.0175	0.02		
Data dispersion, β_d :	Not Specified	0.28	0.18		
Uncertainty, β_u :	0.4	0.15	0.35		
Total Dispersion, β :	0.4	0.4	0.4		
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Superior	

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04 Normal			3.31E+04 Normal			3.96E+04 Normal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 1.71E+04			4.14E+04 2.76E+04			4.92E+04 3.28E+04								
CV or beta (Min Qty, Max Qty)	0.39 0.39			0.31 0.31			0.29 0.29								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01 Normal			3.04E+01 Normal			3.62E+01 Normal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	2.27E+01 1.51E+01			3.65E+01 2.43E+01			4.34E+01 2.89E+01								
CV or beta (Min Qty, Max Qty)	0.46 0.46			0.39 0.39			0.39 0.39								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	8.3E+03	Normal	0.39	9.6E+03	Normal	0.39						
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.2E+05	Normal	0.39	1.7E+05	Normal	0.39						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			20% 0.50								

Comments:

None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: 2011-08-24 Changed DS2 beta from 0.3 to 0.4 to avoid negative probability beyond 1% story drift.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.051a

NISTIR Name

ACI 318 OMF with weak beams and weak joints, beam flexural or shear response, Conc Col & Bm = 24" x 24", Beam one side

Description

ACI318 OMF, beam flexure-shear or shear failure, beam flexural response. Meets the following requirements: (1) Beam Vn < Veq. Costing is on a per joint basis.

Line 132

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

Beams exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.

Beams exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

Beams exhibit residual crack widths > 0.06 in. Spalling of beam cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of beam core concrete may occur. Fracture or buckling of reinf. requiring replacement may occur.

Illustrations



Damage State Probability:

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.0175

0.02

0.03

Data dispersion, β_d :

Not Specified

0.27

0.32

Uncertainty, β_u :

0.4

0.15

0.15

Total Dispersion, β :

0.4

0.4

Correlation (Yes / No)

NO

Data Quality Average

Documentation Quality Superior

Directionality (Yes / No)

YES

Data Relevance Average

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.85E+04	3.25E+04	4.44E+04	2.30E+04	4.00E+04	5.29E+04						
Best fit mean:	2.09E+04			3.18E+04			3.86E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 1.71E+04			3.90E+04 2.60E+04			4.80E+04 3.20E+04								
CV or beta (Min Qty, Max Qty)	0.39 0.39			0.32 0.32			0.30 0.30								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.63E+01	2.87E+01	3.92E+01	2.03E+01	3.53E+01	4.67E+01						
Best fit mean:	1.89E+01			2.87E+01			3.53E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	2.27E+01 1.51E+01			3.44E+01 2.29E+01			4.23E+01 2.82E+01								
CV or beta (Min Qty, Max Qty)	0.46 0.46			0.40 0.40			0.39 0.39								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	4.9E+03	Normal	0.46	7.8E+03	Normal	0.40	9.4E+03	Normal	0.39						
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.1E+05	Normal	0.40	1.6E+05	Normal	0.39						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			20% 0.50								

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Laura Lowes

Revisions:

2011-08-24 Changed DS2 beta from 0.3 to 0.4 to avoid negative probability beyond 1% story drift.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.051b

NISTIR Name
Description

ACI 318 OMF with weak beams and weak joints, beam flexural or shear response, Conc Col & Bm = 24" x 24", Beam both sides
ACI318 OMF, beam flexure-shear or shear failure, beam flexural response. Meets the following requirements: (1) Beam Vn < Veq. Costing is on a per joint basis.

Line 133

Construction Quality: Not Specified
Seismic Installation Conditions: Not Specified

Fragility Unit of Measure:	EA 1
Demand Parameter (unit):	Story Drift Ratio
Number of Damage States:	3

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Beams exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams exhibit residual crack widths > 0.06 in. Spalling of beam cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of beam core concrete may occur. Fracture or buckling of reinf. requiring replacement may occur.		

Illustrations

				
B1041.051a-DS1-1.JPG	B1041.051a-DS2-1.JPG	B1041.051a-DS3-1.JPG		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.0175	0.02	0.03		
Data dispersion, β_d :	Not Specified	0.27	0.32		
Uncertainty, β_u :	0.4	0.15	0.15		
Total Dispersion, β :	0.4	0.4	0.4		
Correlation (Yes / No)	NO	Data Quality Average	Documentation Quality Superior		
Directionality (Yes / No)	YES	Data Relevance Average	Rationality Superior		

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.85E+04	3.25E+04	4.44E+04	2.30E+04	4.00E+04	5.29E+04						
Best fit mean:	2.09E+04			3.18E+04			3.86E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	2.57E+04			3.90E+04			4.80E+04								
CV or beta (Min Qty, Max Qty)	0.39 0.39			0.32 0.32			0.30 0.30								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.63E+01	2.87E+01	3.92E+01	2.03E+01	3.53E+01	4.67E+01						
Best fit mean:	1.89E+01			2.87E+01			3.53E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	2.27E+01			3.44E+01			4.23E+01								
CV or beta (Min Qty, Max Qty)	0.46 0.46			0.40 0.40			0.39 0.39								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	7.8E+03	Normal	0.40	9.4E+03	Normal	0.39						
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.1E+05	Normal	0.40	1.6E+05	Normal	0.39						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		20%	0.50							

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: 2011-08-24 Changed DS2 beta from 0.3 to 0.4 to avoid negative probability beyond 1% story drift.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.052a

NISTIR Name

ACI 318 OMF with weak beams and weak joints, beam flexural or shear response, Conc Col & Bm = 24" x 36", Beam one side

Description

ACI318 OMF, beam flexure-shear or shear failure, beam flexural response. Meets the following requirements: (1) Beam Vn < Veq. Costing is on a per joint basis.

Line 134

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding Round Qty? YES

Allow sum by floor or building? NO

Demand Location (floor above?) No

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

Beams exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.

Beams exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

Beams exhibit residual crack widths > 0.06 in. Spalling of beam cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of beam core concrete may occur. Fracture or buckling of reinf. requiring replacement may occur.

Illustrations



Damage State Probability:

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.0175

0.02

0.03

Data dispersion, β_d :

Not Specified

0.27

0.32

Uncertainty, β_u :

0.4

0.15

0.15

Total Dispersion, β :

0.4

0.4

Correlation (Yes / No)

NO

Data Quality Average

Documentation Quality Superior

Directionality (Yes / No)

YES

Data Relevance Average

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04 Normal			3.31E+04 Normal			3.96E+04 Normal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 1.71E+04			4.14E+04 2.76E+04			4.92E+04 3.28E+04								
CV or beta (Min Qty, Max Qty)	0.39 0.39			0.31 0.31			0.29 0.29								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01 Normal			3.04E+01 Normal			3.62E+01 Normal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	2.27E+01 1.51E+01			3.65E+01 2.43E+01			4.34E+01 2.89E+01								
CV or beta (Min Qty, Max Qty)	0.46 0.46			0.39 0.39			0.39 0.39								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	4.9E+03	Normal	0.46	8.3E+03	Normal	0.39	9.6E+03	Normal	0.39						
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.2E+05	Normal	0.39	1.7E+05	Normal	0.39						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			20% 0.50								

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Laura Lowes

Revisions:

2011-08-24 Changed DS2 beta from 0.3 to 0.4 to avoid negative probability beyond 1% story drift.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.052b

NISTIR Name

ACI 318 OMF with weak beams and weak joints, beam flexural or shear response, Conc Col & Bm = 24" x 36", Beam both sides

Description

ACI318 OMF, beam flexure-shear or shear failure, beam flexural response. Meets the following requirements: (1) Beam Vn < Veq. Costing is on a per joint basis.

Line 135

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding Round Qty? YES

Allow sum by floor or building? NO

Demand Location (floor above?) No

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

Beams exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.

Beams exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

Beams exhibit residual crack widths > 0.06 in. Spalling of beam cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of beam core concrete may occur. Fracture or buckling of reinf. requiring replacement may occur.

Illustrations



Damage State Probability:

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.0175

0.02

0.03

Data dispersion, β_d :

Not Specified

0.27

0.32

Uncertainty, β_u :

0.4

0.15

0.15

Total Dispersion, β :

0.4

0.4

Correlation (Yes / No)

NO

Data Quality Average

Documentation Quality Superior

Directionality (Yes / No)

YES

Data Relevance Average

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00			20.00					
Average Repair Cost (Min Qty, Max Qty)	2.57E+04			4.14E+04			4.92E+04			3.28E+04					
CV or beta (Min Qty, Max Qty)	0.39			0.31			0.29			0.29					
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00			20.00					
Average Repair Time (Min Qty, Max Qty)	2.27E+01			3.65E+01			4.34E+01			2.89E+01					
CV or beta (Min Qty, Max Qty)	0.46			0.39			0.39			0.39					
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	8.3E+03	Normal	0.39	9.6E+03	Normal	0.39						
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.2E+05	Normal	0.39	1.7E+05	Normal	0.39						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%			0%			0%			0%					
Loss of Life (Median, Dispersion)	0%			0%			0%			0%					
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%			0%			20%			0.50					

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Laura Lowes

Revisions:

2011-08-24 Changed DS2 beta from 0.3 to 0.4 to avoid negative probability beyond 1% story drift.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.053a

NISTIR Name
Description

ACI 318 OMF with weak beams and weak joints, beam flexural or shear response, Conc Col & Bm = 36" x 36", Beam one side
ACI318 OMF, beam flexure-shear or shear failure, beam flexural response. Meets the following requirements: (1) Beam Vn < Veq. Costing is on a per joint basis.

Line 136

Construction Quality:	Not Specified					<div>Quantity RoundingRound Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	EA 1					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	3					
Damage State:	DS1		DS2		DS3	
Type of Damage State:	Sequential		Sequential		Sequential	
DS Hierarchy	Seq(DS1.DS2.DS3)					
Descriptions	Beams exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.		Beams exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.		Beams exhibit residual crack widths > 0.06 in. Spalling of beam cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of beam core concrete may occur. Fracture or buckling of reinf. requiring replacement may occur.	

Illustrations

				
B1041.051a-DS1-1.JPG	B1041.051a-DS2-1.JPG	B1041.051a-DS3-1.JPG		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.0175	0.02	0.03		
Data dispersion, β_d :	Not Specified	0.27	0.32		
Uncertainty, β_u :	0.4	0.15	0.15		
Total Dispersion, β :	0.4	0.4	0.4		
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Superior	

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00								
Average Repair Cost (Min Qty, Max Qty)	2.57E+04			4.14E+04			4.92E+04								
CV or beta (Min Qty, Max Qty)	0.39			0.31			0.29								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00								
Average Repair Time (Min Qty, Max Qty)	2.27E+01			3.65E+01			4.34E+01								
CV or beta (Min Qty, Max Qty)	0.46			0.39			0.39								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	8.3E+03	Normal	0.39	9.6E+03	Normal	0.39						
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.2E+05	Normal	0.39	1.7E+05	Normal	0.39						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%			0%			0%								
Loss of Life (Median, Dispersion)	0%			0%			0%								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%			0%			20%								

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: 2011-08-24 Changed DS2 beta from 0.3 to 0.4 to avoid negative probability beyond 1% story drift.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.053b

NISTIR Name
Description

ACI 318 OMF with weak beams and weak joints, beam flexural or shear response, Conc Col & Bm = 36" x 36", Beam both sides
ACI318 OMF, beam flexure-shear or shear failure, beam flexural response. Meets the following requirements: (1) Beam Vn < Veq. Costing is on a per joint basis.

Line 137

Construction Quality: Not Specified
Seismic Installation Conditions: Not Specified

Fragility Unit of Measure:	EA 1
Demand Parameter (unit):	Story Drift Ratio
Number of Damage States:	3

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Beams exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams exhibit residual crack widths > 0.06 in. Spalling of beam cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of beam core concrete may occur. Fracture or buckling of reinf. requiring replacement may occur.		

Illustrations

				
B1041.051a-DS1-1.JPG	B1041.051a-DS2-1.JPG	B1041.051a-DS3-1.JPG		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, δ :	0.0175	0.02	0.03		
Data dispersion, β_d :	Not Specified	0.27	0.32		
Uncertainty, β_u :	0.4	0.15	0.15		
Total Dispersion, β :	0.4	0.4	0.4		
Correlation (Yes / No)	NO	Data Quality Average	Documentation Quality Superior		
Directionality (Yes / No)	YES	Data Relevance Average	Rationality Superior		

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00								
Average Repair Cost (Min Qty, Max Qty)	2.57E+04			4.14E+04			4.92E+04								
CV or beta (Min Qty, Max Qty)	0.39			0.31			0.29								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00								
Average Repair Time (Min Qty, Max Qty)	2.27E+01			3.65E+01			4.34E+01								
CV or beta (Min Qty, Max Qty)	0.46			0.39			0.39								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	8.3E+03	Normal	0.39	9.6E+03	Normal	0.39						
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.2E+05	Normal	0.39	1.7E+05	Normal	0.39						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		20%	0.50							

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: 2011-08-24 Changed DS2 beta from 0.3 to 0.4 to avoid negative probability beyond 1% story drift.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1041.061a

ACI 318 OMF with weak columns, Conc Col & Bm = 24" x 24", Beam one side

ACI318 OMF, column shear or flexural-shear failure, column flexural response. Meets the following requirements: (1) Column Pu < 0.6Agfc, (2) Column Vn < Veq Costing is on a per joint basis.

Line 138

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

EA 1

Story Drift Ratio

3

DS1

Sequential

Seq(DS1,DS2,DS3)

Columns exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinf.

DS2

Sequential

Columns exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes column transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

DS3

Sequential

Columns exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinf. requiring replacement may occur.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations



B1041.051a-DS1-1.JPG



B1041.051a-DS2-1.JPG



B1041.051a-DS3-1.JPG

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.00

Not Specified

0.4

0.4

NO

YES

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.02E+04

2.14E+04

3.11E+04

Normal

5.00

20.00

2.57E+04

0.39

Each

P₁₀

P₅₀

P₉₀

1.85E+04

3.25E+04

4.44E+04

Normal

5.00

20.00

3.90E+04

0.32

Each

P₁₀

P₅₀

P₉₀

2.30E+04

4.00E+04

5.29E+04

Normal

5.00

20.00

4.80E+04

0.30

Each

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

8.98E+00

1.89E+01

2.75E+01

Normal

5.00

20.00

2.27E+01

0.46

Each

P₁₀

P₅₀

P₉₀

1.63E+01

2.87E+01

3.92E+01

Normal

5.00

20.00

3.44E+01

0.40

Each

P₁₀

P₅₀

P₉₀

2.03E+01

3.53E+01

4.67E+01

Normal

5.00

20.00

4.23E+01

0.39

Each

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

4.9E+03

Normal

0.46

Median Cost

Best Fit

CV or Beta

7.8E+03

Normal

0.40

Median Cost

Best Fit

CV or Beta

9.4E+03

Normal

0.39

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

7.3E+04

Normal

0.46

Median Cost

Best Fit

CV or Beta

1.1E+05

Normal

0.40

Median Cost

Best Fit

CV or Beta

1.6E+05

Normal

0.39

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

YES

10%

0.50

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Laura Lowes

2011-08-24 Changed DS2 beta from 0.3 to 0.4 to avoid negative probability beyond 1% story drift.

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1041.061b

ACI 318 OMF with weak columns, Conc Col & Bm = 24" x 24", Beam both sides

ACI318 OMF, column shear or flexural-shear failure, column flexural response. Meets the following requirements: (1) Column Pu < 0.6Agfc, (2) Column Vn < Veq. Costing is on a per joint basis.

Line 139

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)


Descriptions

Columns exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinf.


Columns exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes column transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

Columns exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinf. requiring replacement may occur.


Illustrations



B1041.051a-DS1-1.JPG



B1041.051a-DS2-1.JPG



B1041.051a-DS3-1.JPG

Damage State Probability:

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

NO

Data Quality

Average

Documentation Quality

Superior

Directionality (Yes / No)

YES

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.02E+04

2.14E+04

3.11E+04

Normal

5.00

20.00

2.57E+04

0.39

Each

P₁₀

P₅₀

P₉₀

1.85E+04

3.25E+04

4.44E+04

Normal

5.00

20.00

3.90E+04

0.32

Each

P₁₀

P₅₀

P₉₀

2.30E+04

4.00E+04

5.29E+04

Normal

5.00

20.00

4.80E+04

0.30

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

8.98E+00

1.89E+01

2.75E+01

Normal

5.00

20.00

2.27E+01

0.46

Each

P₁₀

P₅₀

P₉₀

1.63E+01

2.87E+01

3.92E+01

Normal

5.00

20.00

3.44E+01

0.40

Each

P₁₀

P₅₀

P₉₀

2.03E+01

3.53E+01

4.67E+01

Normal

5.00

20.00

4.23E+01

0.39

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

4.9E+03

Normal

0.46

7.8E+03

Normal

0.40

9.4E+03

Normal

0.39

Median Cost

Best Fit

CV or Beta

7.3E+04

Normal

0.46

1.1E+05

Normal

0.40

1.6E+05

Normal

0.39

Median Cost

Best Fit

CV or Beta

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

YES

10%

0.50

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Laura Lowes

Revisions:

2011-08-24 Changed DS2 beta from 0.3 to 0.4 to avoid negative probability beyond 1% story drift.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1041.062a

ACI 318 OMF with weak columns, Conc Col & Bm = 24" x 36", Beam one side

ACI318 OMF, column shear or flexural-shear failure, column flexural response. Meets the following requirements: (1) Column Pu < 0.6Agfc, (2) Column Vn < Veq Costing is on a per joint basis.

Line 140

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

EA 1

Story Drift Ratio

3

DS1

Sequential

Seq(DS1,DS2,DS3)

Columns exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinf.

DS2

Sequential

Columns exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes column transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

DS3

Sequential

Columns exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinf. requiring replacement may occur.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations



B1041.051a-DS1-1.JPG

1.00



B1041.051a-DS2-1.JPG

1.00



B1041.051a-DS3-1.JPG

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ:

Data dispersion, β_d:

Uncertainty, β_u:

Total Dispersion, β:

Correlation (Yes / No)

Directionality (Yes / No)

0.015

Not Specified

0.4

0.4

NO

YES

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.02E+04

2.14E+04

3.11E+04

Normal

5.00

20.00

2.57E+04

0.39

Each

P₁₀

P₅₀

P₉₀

1.95E+04

3.45E+04

4.54E+04

Normal

5.00

20.00

4.14E+04

0.31

Each

P₁₀

P₅₀

P₉₀

2.40E+04

4.10E+04

5.39E+04

Normal

5.00

20.00

4.92E+04

0.29

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

8.98E+00

1.89E+01

2.75E+01

Normal

5.00

20.00

2.27E+01

0.46

Each

P₁₀

P₅₀

P₉₀

1.72E+01

3.04E+01

4.01E+01

Normal

5.00

20.00

3.65E+01

0.39

Each

P₁₀

P₅₀

P₉₀

2.12E+01

3.62E+01

4.76E+01

Normal

5.00

20.00

4.34E+01

0.39

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

4.9E+03

Normal

0.46

Median Cost

Best Fit

CV or Beta

8.3E+03

Normal

0.39

Median Cost

Best Fit

CV or Beta

9.6E+03

Normal

0.39

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

YES

10%

0.50

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Laura Lowes

2011-08-24 Changed DS2 beta from 0.3 to 0.4 to avoid negative probability beyond 1% story drift.



Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification		B1041.062b		Line 141	
NISTIR Name		ACI 318 OMF with weak columns, Conc Col & Bm = 24" x 36", Beam both sides			
Description		ACI318 OMF, column shear or flexural-shear failure, column flexural response. Meets the following requirements: (1) Column Pu < 0.6Ag'c, (2) Column Vn < Veq. Costing is on a per joint basis.			
Construction Quality:		Not Specified			
Seismic Installation Conditions:		Not Specified			
Fragility Unit of Measure:		EA 1		Quantity Rounding Round Qty? YES	
Demand Parameter (unit):		Story Drift Ratio		Allow sum by floor or building? NO	
Number of Damage States:		3		Demand Location (floor above?) No	
Damage State:		DS1		DS2	
Type of Damage State:		Sequential		Sequential	
DS Hierarchy		Seq(DS1,DS2,DS3)		Sequential	
Descriptions		Columns exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinf.		Columns exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes column transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	
				Columns exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinf. requiring replacement may occur.	
Illustrations					
Damage State Probability:		1.00		1.00	
Fragility Parameters					
Median Demand, θ :		0.015		0.0175	
Data dispersion, β_d :		Not Specified		0.27	
Uncertainty, β_u :		0.4		0.15	
Total Dispersion, β :		0.4		0.4	
Correlation (Yes / No)		NO		Data Quality Average	
Directionality (Yes / No)		YES		Documentation Quality Superior	
				Rationality Superior	
Consequence Functions					
Repair Description		Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.		Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	
				Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	
Long Lead Time (Yes / No)		NO		NO	
Repair Costs:		P_{10} P_{50} P_{90}		P_{10} P_{50} P_{90}	
Repair Cost by Damage State:		1.02E+04 2.14E+04 3.11E+04		1.95E+04 3.45E+04 4.54E+04	
Best fit mean:		2.09E+04		3.31E+04	
Best Fit Distribution:		Normal		Normal	
Quantity Plateau (Min Qty, Max Qty)		5.00 20.00		5.00 20.00	
Average Repair Cost (Min Qty, Max Qty)		2.57E+04 1.71E+04		4.14E+04 2.76E+04	
CV or beta (Min Qty, Max Qty)		0.39 0.39		0.31 0.31	
Quantity Unit:		Each		Each	
Repair Time:		P_{10} P_{50} P_{90}		P_{10} P_{50} P_{90}	
Repair Time by Damage State:		8.98E+00 1.89E+01 2.75E+01		1.72E+01 3.04E+01 4.01E+01	
Best fit mean:		1.89E+01		3.04E+01	
Best Fit Distribution:		Normal		Normal	
Quantity Plateau (Min Qty, Max Qty)		5.00 20.00		5.00 20.00	
Average Repair Time (Min Qty, Max Qty)		2.27E+01 1.51E+01		3.65E+01 2.43E+01	
CV or beta (Min Qty, Max Qty)		0.46 0.46		0.39 0.39	
Quantity Unit:		Each		Each	
Environmental Impacts:		Median Cost Best Fit CV or Beta		Median Cost Best Fit CV or Beta	
Embodied Carbon (kg CO2eq)		4.9E+03 Normal 0.46		8.3E+03 Normal 0.39	
Embodied Energy (MJ)		7.3E+04 Normal 0.46		1.2E+05 Normal 0.39	
LifeSafety Hazard:					
Potential non-collapse casualties? (Yes / No)		NO		NO	
Casualty-affected Planar Area (sf) per Normative Unit:		Not Applicable		Not Applicable	
Serious Injury (Median, Dispersion)		0% 0.00		0% 0.00	
Loss of Life (Median, Dispersion)		0% 0.00		0% 0.00	
Post-event Tagging Flag:		NO		YES	
Unsafe Placard Trigger (Median, Dispersion)		0% 0.00		10% 0.50	
Comments:		None			
Date Created:		Not Given			
Approved (YES / NO)?		By User			
Official (YES / NO) ?		By User			
Author:		Laura Lowes			
Revisions:		2011-08-24 Changed DS2 beta from 0.3 to 0.4 to avoid negative probability beyond 1% story drift.			
		Root Cost Multiplier: 1			
		Date Generated: 02/26/19			

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.063a

NISTIR Name

ACI 318 OMF with weak columns, Conc Col & Bm = 36" x 36", Beam one side

Description

ACI318 OMF, column shear or flexural-shear failure, column flexural response. Meets the following requirements: (1) Column Pu < 0.6Agf'c, (2) Column Vn < Veq Costing is on a per joint basis.

Line 142

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

Columns exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinf.

Columns exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes column transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

Columns exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinf. requiring replacement may occur.

Illustrations



Damage State Probability:

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.015

0.0175

0.02

Data dispersion, β_d :

Not Specified

0.27

0.18

Uncertainty, β_u :

0.4

0.15

0.35

Total Dispersion, β :

0.4

0.4

0.4

Correlation (Yes / No)

NO

Data Quality

Average

Documentation Quality

Superior

Directionality (Yes / No)

YES

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 1.71E+04			4.14E+04 2.76E+04			4.92E+04 3.28E+04								
CV or beta (Min Qty, Max Qty)	0.39 0.39			0.31 0.31			0.29 0.29								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	2.27E+01 1.51E+01			3.65E+01 2.43E+01			4.34E+01 2.89E+01								
CV or beta (Min Qty, Max Qty)	0.46 0.46			0.39 0.39			0.39 0.39								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	4.9E+03	Normal	0.46	8.3E+03	Normal	0.39	9.6E+03	Normal	0.39						
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.2E+05	Normal	0.39	1.7E+05	Normal	0.39						
LifeSafety Hazard:	Potential non-collapse casualties? (Yes / No)	NO			Potential non-collapse casualties? (Yes / No)	NO				Potential non-collapse casualties? (Yes / No)	NO				
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			10% 0.50								

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Laura Lowes

Revisions:

2011-08-24 Changed DS2 beta from 0.3 to 0.4 to avoid negative probability beyond 1% story drift.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1041.063b

ACI 318 OMF with weak columns, Conc Col & Bm = 36" x 36", Beam both sides

ACI318 OMF, column shear or flexural-shear failure, column flexural response. Meets the following requirements: (1) Column Pu < 0.6Agfc, (2) Column Vn < Veq. Costing is on a per joint basis.

Line 143

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

EA 1

Story Drift Ratio

3

DS1

Sequential

Seq(DS1,DS2,DS3)

Columns exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinf.

DS2

Sequential

Columns exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes column transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

DS3

Sequential

Columns exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinf. requiring replacement may occur.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations



B1041.051a-DS1-1.JPG



B1041.051a-DS2-1.JPG



B1041.051a-DS3-1.JPG

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.00

0.015

Not Specified

0.4

0.4

NO

YES

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

1.02E+04

2.14E+04

3.11E+04

P₁₀

P₅₀

P₉₀

1.95E+04

3.45E+04

4.54E+04

P₁₀

P₅₀

P₉₀

2.40E+04

4.10E+04

5.39E+04

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.09E+04

Normal

5.00

20.00

2.57E+04

1.71E+04

0.39

0.39

Each

3.31E+04

Normal

5.00

20.00

4.14E+04

2.76E+04

0.31

0.31

Each

3.96E+04

Normal

5.00

20.00

4.92E+04

3.28E+04

0.29

0.29

Each

P₁₀

P₅₀

P₉₀

1.89E+01

Normal

5.00

20.00

2.27E+01

1.51E+01

0.46

0.46

Each

P₁₀

P₅₀

P₉₀

1.72E+01

3.04E+01

4.01E+01

P₁₀

P₅₀

P₉₀

2.12E+01

3.62E+01

4.76E+01

P₁₀

P₅₀

P₉₀

Median Cost

Best Fit

CV or Beta

4.9E+03

Normal

0.46

Median Cost

Best Fit

CV or Beta

8.3E+03

Normal

0.39

Median Cost

Best Fit

CV or Beta

9.6E+03

Normal

0.39

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

7.3E+04

Normal

0.46

Median Cost

Best Fit

CV or Beta

1.2E+05

Normal

0.39

Median Cost

Best Fit

CV or Beta

1.7E+05

Normal

0.39

Median Cost

Best Fit

CV or Beta

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

YES

10%

0.50

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Laura Lowes

2011-08-24 Changed DS2 beta from 0.3 to 0.4 to avoid negative probability beyond 1% story drift.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.071a

NISTIR Name

ACI 318 OMF weak columns w/ high axial load, Conc Col & Bm = 24" x 24", Beam one side

Description

ACI318 OMF, column flexure, flexural-shear, or shear failure at high axial load. Column flexural-shear response. Meets the following requirements: (1) Column Pu > 0.6Agfc, (2) Column Vn < Veq Costing is on a per joint basis.

Line 144

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding

Round Qty? YES

Allow sum by floor or building? NO

Demand Location (floor above?) No

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Concrete Cracking: beams, joints or possibly. Residual concrete crack widths exceed 0.06in. (1.5 mm). Column exhibits residual crack widths that require epoxy injection.

Concrete Crushing: slabs, beams or joints. Spalling of beam, column or joint cover concrete exposes longitudinal reinforcement or strength loss initiates in laboratory testing. Exhibits concrete spalling that exposes longitudinal steel or crushing of core concrete.

Illustrations



Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.0025

0.005

Data dispersion, β_d :

Not Specified

Not Specified

Uncertainty, β_u :

0.4

0.5

Total Dispersion, β :

0.4

0.5

Correlation (Yes / No)

NO

Data Quality Marginal

Documentation Quality Superior

Directionality (Yes / No)

YES

Data Relevance Average

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.85E+04	3.25E+04	4.44E+04									
Best fit mean:	2.09E+04			3.18E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00											
Average Repair Cost (Min Qty, Max Qty)	2.57E+04			3.90E+04											
CV or beta (Min Qty, Max Qty)	0.39			0.32											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.63E+01	2.87E+01	3.92E+01									
Best fit mean:	1.89E+01			2.87E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00											
Average Repair Time (Min Qty, Max Qty)	2.27E+01			3.44E+01											
CV or beta (Min Qty, Max Qty)	0.46			0.40											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	7.8E+03	Normal	0.40									
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.1E+05	Normal	0.40									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		10%	0.50										

Comments:

This fragility has been changed to match B1041.121. ASCE6 is closest to column high axial OMF.

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Laura Lowes

Revisions:

2011-08-24 Negative probability below 0.1% drift - overlap deemed acceptable.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.071b

NISTIR Name

ACI 318 OMF weak columns w/ high axial load, Conc Col & Bm = 24" x 24", Beam both sides

Description

ACI318 OMF, column flexure, flexural-shear, or shear failure at high axial load. Column flexural-shear response. Meets the following requirements: (1) Column Pu > 0.6Agfc, (2) Column Vn < Veq Costing is on a per joint basis.

Line 145

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding Round Qty? YES

Allow sum by floor or building? NO

Demand Location (floor above?) No

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Concrete Cracking: beams, joints or possibly. Residual concrete crack widths exceed 0.06in. (1.5 mm). Column exhibits residual crack widths that require epoxy injection.

Concrete Crushing: slabs, beams or joints. Spalling of beam, column or joint cover concrete exposes longitudinal reinforcement or strength loss initiates in laboratory testing. Exhibits concrete spalling that exposes longitudinal steel or crushing of core concrete.

Illustrations



Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.0025

0.005

Data dispersion, β_d :

Not Specified

Not Specified

Uncertainty, β_u :

0.4

0.5

Total Dispersion, β :

0.4

0.5

Correlation (Yes / No)

NO

Data Quality Marginal

Documentation Quality Superior

Directionality (Yes / No)

YES

Data Relevance Average

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.85E+04	3.25E+04	4.44E+04									
Best fit mean:	2.09E+04			3.18E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00											
Average Repair Cost (Min Qty, Max Qty)	2.57E+04			3.90E+04											
CV or beta (Min Qty, Max Qty)	0.39			0.32											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.63E+01	2.87E+01	3.92E+01									
Best fit mean:	1.89E+01			2.87E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00											
Average Repair Time (Min Qty, Max Qty)	2.27E+01			3.44E+01											
CV or beta (Min Qty, Max Qty)	0.46			0.40											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	7.8E+03	Normal	0.40									
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.1E+05	Normal	0.40									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		10%	0.50										

Comments:

This fragility has been changed to match B1041.121. ASCE6 is closest to column high axial OMF.

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Laura Lowes

Revisions:

2011-08-24 Negative probability below 0.1% drift - overlap deemed acceptable.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.072a

NISTIR Name

ACI 318 OMF weak columns w/ high axial load, Conc Col & Bm = 24" x 36", Beam one side

Description

ACI318 OMF, column flexure, flexural-shear, or shear failure at high axial load. Column flexural-shear response. Meets the following requirements: (1) Column Pu > 0.6Agfc, (2) Column Vn < Veq Costing is on a per joint basis.

Line 146

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding Round Qty? YES

Allow sum by floor or building? NO

Demand Location (floor above?) No

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Concrete Cracking: beams, joints or possibly. Residual concrete crack widths exceed 0.06in. (1.5 mm). Column exhibits residual crack widths that require epoxy injection.

Concrete Crushing: slabs, beams or joints. Spalling of beam, column or joint cover concrete exposes longitudinal reinforcement or strength loss initiates in laboratory testing. Exhibits concrete spalling that exposes longitudinal steel or crushing of core concrete.

Illustrations



Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.0025

0.005

Data dispersion, β_d :

Not Specified

Not Specified

Uncertainty, β_u :

0.4

0.5

Total Dispersion, β :

0.4

0.5

Correlation (Yes / No)

NO

Data Quality Marginal

Documentation Quality Superior

Directionality (Yes / No)

YES

Data Relevance Average

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04									
Best fit mean:	2.09E+04			3.31E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00											
Average Repair Cost (Min Qty, Max Qty)	2.57E+04			4.14E+04											
CV or beta (Min Qty, Max Qty)	0.39			0.31											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01									
Best fit mean:	1.89E+01			3.04E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00											
Average Repair Time (Min Qty, Max Qty)	2.27E+01			3.65E+01											
CV or beta (Min Qty, Max Qty)	0.46			0.39											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	8.3E+03	Normal	0.39									
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.2E+05	Normal	0.39									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		10%	0.50										

Comments:

This fragility has been changed to match B1041.121. ASCE6 is closest to column high axial OMF.

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Laura Lowes

Revisions:

2011-08-24 Negative probability below 0.1% drift - overlap deemed acceptable.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.072b

NISTIR Name
Description

ACI 318 OMF weak columns w/ high axial load, Conc Col & Bm = 24" x 36", Beam both sides
ACI318 OMF, column flexure, flexural-shear, or shear failure at high axial load. Column flexural-shear response. Meets the following requirements: (1) Column Pu > 0.6Agfc, (2) Column Vn < Veq Costing is on a per joint basis.

Line 147

Construction Quality:	Not Specified					<div>Quantity RoundingRound Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	EA 1					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Concrete Cracking: beams, joints or possibly. Residual concrete crack widths exceed 0.06in. (1.5 mm). Column exhibits residual crack widths that require epoxy injection.		Concrete Crushing: slabs, beams or joints. Spalling of beam, column or joint cover concrete exposes longitudinal reinforcement or strength loss initiates in laboratory testing. Exhibits concrete spalling that exposes longitudinal steel or crushing of core concrete.			

Illustrations

				
B1041.071a-DS1-2.JPG	B1041.071a-DS2-1.JPG			
1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.0025	0.005			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	0.4	0.5			
Total Dispersion, β :	0.4	0.5			
Correlation (Yes / No)	NO	Data Quality Marginal	Documentation Quality Superior		
Directionality (Yes / No)	YES	Data Relevance Average	Rationality Superior		

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04									
Best fit mean:	2.09E+04			3.31E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00											
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 1.71E+04			4.14E+04 2.76E+04											
CV or beta (Min Qty, Max Qty)	0.39 0.39			0.31 0.31											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01									
Best fit mean:	1.89E+01			3.04E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00											
Average Repair Time (Min Qty, Max Qty)	2.27E+01 1.51E+01			3.65E+01 2.43E+01											
CV or beta (Min Qty, Max Qty)	0.46 0.46			0.39 0.39											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	8.3E+03	Normal	0.39									
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.2E+05	Normal	0.39									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			10% 0.50											

Comments: This fragility has been changed to match B1041.121. ASCE6 is closest to column high axial OMF.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: 2011-08-24 Negative probability below 0.1% drift - overlap deemed acceptable.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.073a

NISTIR Name

ACI 318 OMF weak columns w/ high axial load, Conc Col & Bm = 36" x 36", Beam one side

Description

ACI318 OMF, column flexure, flexural-shear, or shear failure at high axial load. Column flexural-shear response. Meets the following requirements: (1) Column Pu > 0.6Agfc, (2) Column Vn < Veq Costing is on a per joint basis.

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Concrete Cracking: beams, joints or possibly. Residual concrete crack widths exceed 0.06in. (1.5 mm). Column exhibits residual crack widths that require epoxy injection.

Concrete Crushing: slabs, beams or joints. Spalling of beam, column or joint cover concrete exposes longitudinal reinforcement or strength loss initiates in laboratory testing. Exhibits concrete spalling that exposes longitudinal steel or crushing of core concrete.

Quantity Rounding

Round Qty? YES

Allow sum by floor or building? NO

Demand Location (floor above?) No

Illustrations



Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.0025

0.005

Data dispersion, β_d :

Not Specified

Not Specified

Uncertainty, β_u :

0.4

0.5

Total Dispersion, β :

0.4

0.5

Correlation (Yes / No)

NO

Data Quality Marginal

Documentation Quality Superior

Directionality (Yes / No)

YES

Data Relevance Average

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04									
Best fit mean:	2.09E+04			3.31E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00											
Average Repair Cost (Min Qty, Max Qty)	2.57E+04			4.14E+04											
CV or beta (Min Qty, Max Qty)	0.39			0.31											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01									
Best fit mean:	1.89E+01			3.04E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00											
Average Repair Time (Min Qty, Max Qty)	2.27E+01			3.65E+01											
CV or beta (Min Qty, Max Qty)	0.46			0.39											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	8.3E+03	Normal	0.39									
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.2E+05	Normal	0.39									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		10%	0.50										

Comments:

This fragility has been changed to match B1041.121. ASCE6 is closest to column high axial OMF.

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Laura Lowes

Revisions:

2011-08-24 Negative probability below 0.1% drift - overlap deemed acceptable.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.073b

NISTIR Name

ACI 318 OMF weak columns w/ high axial load, Conc Col & Bm = 36" x 36", Beam both sides

Description

ACI318 OMF, column flexure, flexural-shear, or shear failure at high axial load. Column flexural-shear response. Meets the following requirements: (1) Column Pu > 0.6Agfc, (2) Column Vn < Veq Costing is on a per joint basis.

Line 149

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Concrete Cracking: beams, joints or possibly. Residual concrete crack widths exceed 0.06in. (1.5 mm). Column exhibits residual crack widths that require epoxy injection.

Concrete Crushing: slabs, beams or joints. Spalling of beam, column or joint cover concrete exposes longitudinal reinforcement or strength loss initiates in laboratory testing. Exhibits concrete spalling that exposes longitudinal steel or crushing of core concrete.

Illustrations

				
B1041.071a-DS1-2.JPG	B1041.071a-DS2-1.JPG			
1.00	1.00			

Damage State Probability:

Fragility Parameters

Median Demand, θ :

0.0025

0.005

Data dispersion, β_d :

Not Specified

Not Specified

Uncertainty, β_u :

0.4

0.5

Total Dispersion, β :

0.4

0.5

Correlation (Yes / No)

NO

Data Quality Marginal

Documentation Quality Superior

Directionality (Yes / No)

YES

Data Relevance Average

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04									
Best fit mean:	2.09E+04			3.31E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00											
Average Repair Cost (Min Qty, Max Qty)	2.57E+04			4.14E+04											
CV or beta (Min Qty, Max Qty)	0.39			0.31											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01									
Best fit mean:	1.89E+01			3.04E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00											
Average Repair Time (Min Qty, Max Qty)	2.27E+01			3.65E+01											
CV or beta (Min Qty, Max Qty)	0.46			0.39											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	8.3E+03	Normal	0.39									
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.2E+05	Normal	0.39									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		10%	0.50										

Comments:

This fragility has been changed to match B1041.121. ASCE6 is closest to column high axial OMF.

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Laura Lowes

Revisions:

2011-08-24 Negative probability below 0.1% drift - overlap deemed acceptable.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.081a

Line 150

NISTIR Name

Non-conforming MF with weak joints and beam flexural response, Conc Col & Bm = 24" x 24", Beam one side

Description

Non-Conforming MF, joint shear failure, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) ASCE41 non-compliant joint transverse reinforcing and or joint V/Vn > 1.2, (3) IGH beam ductility per ASCE41-06 Table 6-7i, (4) Compliant beam transverse reinforcing with LOW beam V / bwd(f'c)^{0.5}. Costing is on a per joint basis.

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

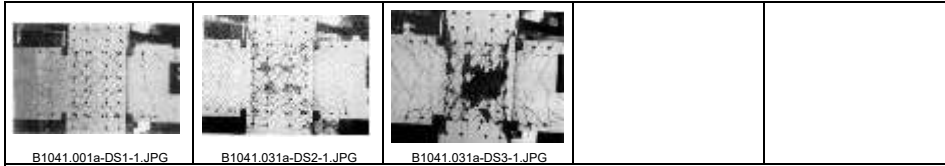
Descriptions

Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.

Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement or column longitudinal reinforcement in the joint. Crushing of beam or joint core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.

Illustrations



Damage State Probability:

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.0175

0.0225

0.0322

Data dispersion, β_d :

0.17

0.27

0.32

Uncertainty, β_u :

0.3

0.13

0.15

Total Dispersion, β :

0.4

0.4

0.4

Correlation (Yes / No)

NO

Data Quality

Marginal

Documentation Quality

Superior

Directionality (Yes / No)

YES

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.85E+04	3.25E+04	4.44E+04	2.30E+04	4.00E+04	5.29E+04						
Best fit mean:	2.09E+04			3.18E+04			3.86E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 0.39			3.90E+04 0.32			4.80E+04 0.30								
CV or beta (Min Qty, Max Qty)	Each			Each			Each								
Quantity Unit:															
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.63E+01	2.87E+01	3.92E+01	2.03E+01	3.53E+01	4.67E+01						
Best fit mean:	1.89E+01			2.87E+01			3.53E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	2.27E+01 0.46			3.44E+01 0.40			4.23E+01 0.39								
CV or beta (Min Qty, Max Qty)	Each			Each			Each								
Quantity Unit:															
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	4.9E+03	Normal	0.46	7.8E+03	Normal	0.40	9.4E+03	Normal	0.39						
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.1E+05	Normal	0.40	1.6E+05	Normal	0.39						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			20% 0.50								

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Laura Lowes

Revisions:

2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.081b

NISTIR Name

Non-conforming MF with weak joints and beam flexural response, Conc Col & Bm = 24" x 24", Beam both sides

Description

Non-Conforming MF, joint shear failure, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) ASCE41 non-compliant joint transverse reinforcing and or joint V/Vn > 1.2, (3) IGH beam ductility per ASCE41-06 Table 6-7i, (4) Compliant beam transverse reinforcing with LOW beam V / bwd(f'c)^0.5. Costing is on a per joint basis.

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

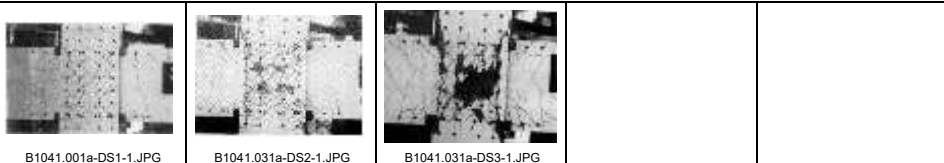
Descriptions

Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.

Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement or column longitudinal reinforcement in the joint. Crushing of beam or joint core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.

Illustrations



Damage State Probability:

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.0175

0.0225

0.0322

Data dispersion, β_d :

0.17

0.27

0.32

Uncertainty, β_u :

0.3

0.13

0.15

Total Dispersion, β :

0.4

0.4

0.4

Correlation (Yes / No)

NO

Directionality (Yes / No)

YES

Data Quality Marginal

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.85E+04	3.25E+04	4.44E+04	2.30E+04	4.00E+04	5.29E+04						
Best fit mean:	2.09E+04 Normal			3.18E+04 Normal			3.86E+04 Normal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 1.71E+04			3.90E+04 2.60E+04			4.80E+04 3.20E+04								
CV or beta (Min Qty, Max Qty)	0.39 0.39			0.32 0.32			0.30 0.30								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.63E+01	2.87E+01	3.92E+01	2.03E+01	3.53E+01	4.67E+01						
Best fit mean:	1.89E+01 Normal			2.87E+01 Normal			3.53E+01 Normal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	2.27E+01 1.51E+01			3.44E+01 2.29E+01			4.23E+01 2.82E+01								
CV or beta (Min Qty, Max Qty)	0.46 0.46			0.40 0.40			0.39 0.39								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	7.8E+03	Normal	0.40	9.4E+03	Normal	0.39						
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.1E+05	Normal	0.40	1.6E+05	Normal	0.39						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			20% 0.50								

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Laura Lowes

Revisions:

2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.082a

NISTIR Name

Non-conforming MF with weak joints and beam flexural response, Conc Col & Bm = 24" x 36", Beam one side

Description

Non-Conforming MF, joint shear failure, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) ASCE41 non-compliant joint transverse reinforcing and or joint V/Vn > 1.2, (3) IGH beam ductility per ASCE41-06 Table 6-7i, (4) Compliant beam transverse reinforcing with LOW beam V / bwd(f'c)^{0.5}. Costing is on a per joint basis.

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.

Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement or column longitudinal reinforcement in the joint. Crushing of beam or joint core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.

Quantity Rounding

Round Qty?

YES

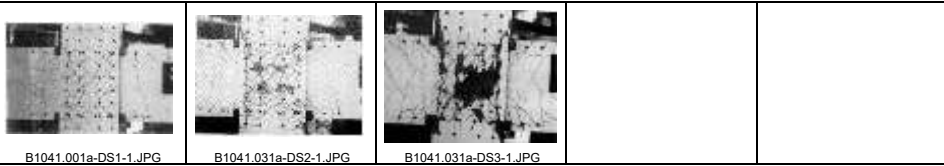
Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations



Damage State Probability:

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.0175

0.0225

0.0322

Data dispersion, β_d :

0.17

0.27

0.32

Uncertainty, β_u :

0.3

0.13

0.15

Total Dispersion, β :

0.4

0.4

0.4

Correlation (Yes / No)

NO

Directionality (Yes / No)

YES

Data Quality Marginal

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00								
Average Repair Cost (Min Qty, Max Qty)	2.57E+04			4.14E+04			4.92E+04								
CV or beta (Min Qty, Max Qty)	0.39			0.31			0.29								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00								
Average Repair Time (Min Qty, Max Qty)	2.27E+01			3.65E+01			4.34E+01								
CV or beta (Min Qty, Max Qty)	0.46			0.39			0.39								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	4.9E+03	Normal	0.46	8.3E+03	Normal	0.39	9.6E+03	Normal	0.39						
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.2E+05	Normal	0.39	1.7E+05	Normal	0.39						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%			0%			0%								
Loss of Life (Median, Dispersion)	0%			0%			0%								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%			0%			20%								

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Laura Lowes

Revisions:

2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.082b

NISTIR Name

Non-conforming MF with weak joints and beam flexural response, Conc Col & Bm = 24" x 36", Beam both sides

Description

Non-Conforming MF, joint shear failure, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) ASCE41 non-compliant joint transverse reinforcing and or joint V/Vn > 1.2, (3) IGH beam ductility per ASCE41-06 Table 6-7i, (4) Compliant beam transverse reinforcing with LOW beam V / bwd(f'c)^{0.5}. Costing is on a per joint basis.

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.

Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement or column longitudinal reinforcement in the joint. Crushing of beam or joint core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.

Quantity Rounding

Round Qty?

YES

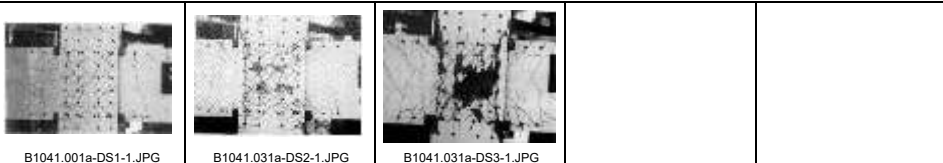
Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations



Damage State Probability:

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.0175

0.0225

0.0322

Data dispersion, β_d :

0.17

0.27

0.32

Uncertainty, β_u :

0.3

0.13

0.15

Total Dispersion, β :

0.4

0.4

0.4

Correlation (Yes / No)

NO

Directionality (Yes / No)

YES

Data Quality Marginal

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00								
Average Repair Cost (Min Qty, Max Qty)	2.57E+04			4.14E+04			4.92E+04								
CV or beta (Min Qty, Max Qty)	0.39			0.31			0.29								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00								
Average Repair Time (Min Qty, Max Qty)	2.27E+01			3.65E+01			4.34E+01								
CV or beta (Min Qty, Max Qty)	0.46			0.39			0.39								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	4.9E+03	Normal	0.46	8.3E+03	Normal	0.39	9.6E+03	Normal	0.39						
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.2E+05	Normal	0.39	1.7E+05	Normal	0.39						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%			0%			0%								
Loss of Life (Median, Dispersion)	0%			0%			0%								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%			0%			20%								

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Laura Lowes

Revisions:

2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.083a

NISTIR Name

Non-conforming MF with weak joints and beam flexural response, Conc Col & Bm = 36" x 36", Beam one side

Description

Non-Conforming MF, joint shear failure, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) ASCE41 non-compliant joint transverse reinforcing and or joint V/Vn > 1.2, (3) IGH beam ductility per ASCE41-06 Table 6-7i, (4) Compliant beam transverse reinforcing with LOW beam V / bwd(f'c)^{0.5}. Costing is on a per joint basis.

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.

Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement or column longitudinal reinforcement in the joint. Crushing of beam or joint core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.

Quantity Rounding

Round Qty?

YES

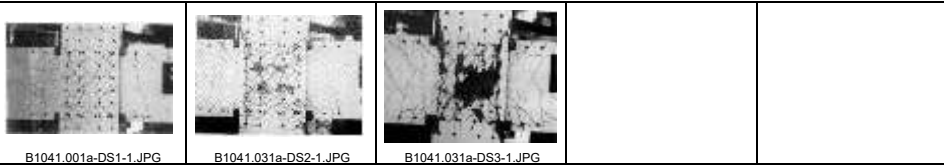
Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations



Damage State Probability:

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.0175

0.0225

0.0322

Data dispersion, β_d :

0.17

0.27

0.32

Uncertainty, β_u :

0.3

0.13

0.15

Total Dispersion, β :

0.4

0.4

0.4

Correlation (Yes / No)

NO

Directionality (Yes / No)

YES

Data Quality Marginal

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 1.71E+04			4.14E+04 2.76E+04			4.92E+04 3.28E+04								
CV or beta (Min Qty, Max Qty)	0.39 0.39			0.31 0.31			0.29 0.29								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	2.27E+01 1.51E+01			3.65E+01 2.43E+01			4.34E+01 2.89E+01								
CV or beta (Min Qty, Max Qty)	0.46 0.46			0.39 0.39			0.39 0.39								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	8.3E+03	Normal	0.39	9.6E+03	Normal	0.39						
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.2E+05	Normal	0.39	1.7E+05	Normal	0.39						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			20% 0.50								

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Laura Lowes

Revisions:

2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.083b

NISTIR Name

Non-conforming MF with weak joints and beam flexural response, Conc Col & Bm = 36" x 36", Beam both sides

Description

Non-Conforming MF, joint shear failure, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) ASCE41 non-compliant joint transverse reinforcing and or joint V/Vn > 1.2, (3) IGH beam ductility per ASCE41-06 Table 6-7i, (4) Compliant beam transverse reinforcing with LOW beam V / bwd(f'c)^{0.5}. Costing is on a per joint basis.

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.

Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement or column longitudinal reinforcement in the joint. Crushing of beam or joint core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.

Quantity Rounding

Round Qty?

YES

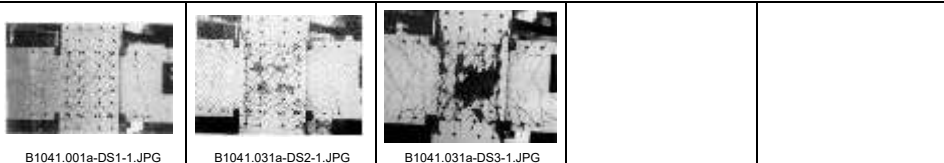
Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations



Damage State Probability:

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.0175

0.0225

0.0322

Data dispersion, β_d :

0.17

0.27

0.32

Uncertainty, β_u :

0.3

0.13

0.15

Total Dispersion, β :

0.4

0.4

0.4

Correlation (Yes / No)

NO

Directionality (Yes / No)

YES

Data Quality Marginal

Documentation Quality Superior

Data Relevance Average

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00								
Average Repair Cost (Min Qty, Max Qty)	2.57E+04			4.14E+04			4.92E+04								
CV or beta (Min Qty, Max Qty)	0.39			0.31			0.29								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00								
Average Repair Time (Min Qty, Max Qty)	2.27E+01			3.65E+01			4.34E+01								
CV or beta (Min Qty, Max Qty)	0.46			0.39			0.39								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	4.9E+03	Normal	0.46	8.3E+03	Normal	0.39	9.6E+03	Normal	0.39						
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.2E+05	Normal	0.39	1.7E+05	Normal	0.39						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%			0%			0%								
Loss of Life (Median, Dispersion)	0%			0%			0%								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%			0%			20%								

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Laura Lowes

Revisions:

2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.091a

NISTIR Name

Non-conforming MF with weak joints and column flexural response, Conc Col & Bm = 24" x 24", Beam one side

Description

Non-Conforming MF, joint shear failure, column flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam < 0.8, (2) [...TBD...], (3) Non-compliant column transverse reinforcement and or joint V/Vn > 1.2 Costing is on a per joint basis.

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

Columns exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinf.

Columns exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes column transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

Columns exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.

Quantity Rounding

Round Qty? YES

Allow sum by floor or building? NO

Demand Location (floor above?) No

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:

Fragility Parameters

Median Demand, θ :

0.015

0.0175

0.02

Data dispersion, β_d :

Not Specified

0.27

0.18

Uncertainty, β_u :

0.4

0.15

0.35

Total Dispersion, β :

0.4

0.4

Correlation (Yes / No)

NO

Data Quality Marginal

Documentation Quality Superior

Directionality (Yes / No)

YES

Data Relevance Average

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.85E+04	3.25E+04	4.44E+04	2.30E+04	4.00E+04	5.29E+04						
Best fit mean:	2.09E+04			3.18E+04			3.86E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00			20.00					
Average Repair Cost (Min Qty, Max Qty)	2.57E+04			3.90E+04			4.80E+04			3.20E+04					
CV or beta (Min Qty, Max Qty)	0.39			0.32			0.30			0.30					
Quantity Unit:	Each			Each			Each								
Repair Time:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.63E+01	2.87E+01	3.92E+01	2.03E+01	3.53E+01	4.67E+01						
Best fit mean:	1.89E+01			2.87E+01			3.53E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00			20.00					
Average Repair Time (Min Qty, Max Qty)	2.27E+01			3.44E+01			4.23E+01			2.82E+01					
CV or beta (Min Qty, Max Qty)	0.46			0.40			0.39			0.39					
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	7.8E+03	Normal	0.40	9.4E+03	Normal	0.39						
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.1E+05	Normal	0.40	1.6E+05	Normal	0.39						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		15%	0.50							

Comments:

This fragility is same as B1041.061. Closest match available.

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Laura Lowes

Revisions:

2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.091b

NISTIR Name
Description

Non-conforming MF with weak joints and column flexural response, Conc Col & Bm = 24" x 24", Beam both sides
Non-Conforming MF, joint shear failure, column flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam < 0.8, (2) [...TBD...], (3) Non-compliant column transverse reinforcement and or joint V/Vn > 1.2 Costing is on a per joint basis.

Line 157

Construction Quality:	Not Specified					<div>Quantity RoundingRound Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	EA 1					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	3					
Damage State:	DS1	DS2	DS3			
Type of Damage State:	Sequential	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2,DS3)					
Descriptions	Columns exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinf.	Columns exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes column transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Columns exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.			

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.015	0.0175	0.02		
Data dispersion, β_d :	Not Specified	0.27	0.18		
Uncertainty, β_u :	0.4	0.15	0.35		
Total Dispersion, β :	0.4	0.4	0.4		
Correlation (Yes / No)	NO	Data Quality Marginal	Documentation Quality Superior		
Directionality (Yes / No)	YES	Data Relevance Average	Rationality Superior		

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.85E+04	3.25E+04	4.44E+04	2.30E+04	4.00E+04	5.29E+04						
Best fit mean:	2.09E+04			3.18E+04			3.86E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00								
Average Repair Cost (Min Qty, Max Qty)	2.57E+04			3.90E+04			4.80E+04								
CV or beta (Min Qty, Max Qty)	0.39			0.32			0.30								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.63E+01	2.87E+01	3.92E+01	2.03E+01	3.53E+01	4.67E+01						
Best fit mean:	1.89E+01			2.87E+01			3.53E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00								
Average Repair Time (Min Qty, Max Qty)	2.27E+01			3.44E+01			4.23E+01								
CV or beta (Min Qty, Max Qty)	0.46			0.40			0.39								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	7.8E+03	Normal	0.40	9.4E+03	Normal	0.39						
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.1E+05	Normal	0.40	1.6E+05	Normal	0.39						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		15%	0.50							

Comments: This fragility is same as B1041.061. Closest match available.

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Laura Lowes

Revisions: 2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.092a

Line 158

NISTIR Name
Description

Non-conforming MF with weak joints and column flexural response, Conc Col & Bm = 24" x 36", Beam one side
Non-Conforming MF, joint shear failure, column flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam < 0.8, (2) [...TBD...], (3) Non-compliant column transverse reinforcement and or joint V/Vn > 1.2 Costing is on a per joint basis.

Construction Quality: Not Specified
Seismic Installation Conditions: Not Specified

Fragility Unit of Measure:	EA 1
Demand Parameter (unit):	Story Drift Ratio
Number of Damage States:	3

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Columns exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinf.	Columns exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes column transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Columns exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.		

Illustrations

none	none	none			
1.00	1.00	1.00			

Damage State Probability:

Fragility Parameters					
Median Demand, θ :	0.015	0.0175	0.02		
Data dispersion, β_d :	Not Specified	0.27	0.18		
Uncertainty, β_u :	0.4	0.15	0.35		
Total Dispersion, β :	0.4	0.4	0.4		

Correlation (Yes / No) NO Data Quality Marginal Documentation Quality Superior
Directionality (Yes / No) YES Data Relevance Average Rationality Superior

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00								
Average Repair Cost (Min Qty, Max Qty)	2.68E+04			4.31E+04			5.12E+04								
CV or beta (Min Qty, Max Qty)	0.39			0.31			0.29								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00								
Average Repair Time (Min Qty, Max Qty)	2.36E+01			3.80E+01			4.52E+01								
CV or beta (Min Qty, Max Qty)	0.46			0.39			0.39								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	8.3E+03	Normal	0.39	9.6E+03	Normal	0.39						
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.2E+05	Normal	0.39	1.7E+05	Normal	0.39						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		15%	0.50							

Comments:

This fragility is same as B1041.061. Closest match available.

Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions:

Root Cost Multiplier: 1
Date Generated: 02/26/19

2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.092b

NISTIR Name
Description

Non-conforming MF with weak joints and column flexural response, Conc Col & Bm = 24" x 36", Beam both sides
Non-Conforming MF, joint shear failure, column flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam < 0.8, (2) [...TBD...], (3) Non-compliant column transverse reinforcement and or joint V/Vn > 1.2 Costing is on a per joint basis.

Line 159

Construction Quality:	Not Specified					Quantity Rounding Round Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	EA 1					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	3					
Damage State:	DS1		DS2		DS3	
Type of Damage State:	Sequential		Sequential		Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)					
Descriptions	Columns exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinf.		Columns exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes column transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.		Columns exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.	

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.015	0.0175	0.02		
Data dispersion, β_d :	Not Specified	0.27	0.18		
Uncertainty, β_u :	0.4	0.15	0.35		
Total Dispersion, β :	0.4	0.4	0.4		
Correlation (Yes / No)	NO	Data Quality Marginal	Documentation Quality Superior		
Directionality (Yes / No)	YES	Data Relevance Average	Rationality Superior		

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00								
Average Repair Cost (Min Qty, Max Qty)	2.68E+04			4.31E+04			5.12E+04								
CV or beta (Min Qty, Max Qty)	0.39			0.31			0.29								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00								
Average Repair Time (Min Qty, Max Qty)	2.36E+01			3.80E+01			4.52E+01								
CV or beta (Min Qty, Max Qty)	0.46			0.39			0.39								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	8.3E+03	Normal	0.39	9.6E+03	Normal	0.39						
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.2E+05	Normal	0.39	1.7E+05	Normal	0.39						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		15%	0.50							

Comments: This fragility is same as B1041.061. Closest match available.

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Laura Lowes

Revisions: 2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.093a

NISTIR Name

Non-conforming MF with weak joints and column flexural response, Conc Col & Bm = 36" x 36", Beam one side

Description

Non-Conforming MF, joint shear failure, column flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam < 0.8, (2) [...TBD...], (3) Non-compliant column transverse reinforcement and or joint V/Vn > 1.2. Costing is on a per joint basis.

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

Columns exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinf.

Columns exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes column transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

Columns exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.

Quantity Rounding

Round Qty? YES

Allow sum by floor or building? NO

Demand Location (floor above?) No

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:

Fragility Parameters

Median Demand, θ :

0.015

0.0175

0.02

Data dispersion, β_d :

Not Specified

0.27

0.18

Uncertainty, β_u :

0.4

0.15

0.35

Total Dispersion, β :

0.4

0.4

0.4

Correlation (Yes / No)

NO

Data Quality

Marginal

Documentation Quality

Superior

Directionality (Yes / No)

YES

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00								
Average Repair Cost (Min Qty, Max Qty)	2.68E+04			4.31E+04			5.12E+04								
CV or beta (Min Qty, Max Qty)	0.39			0.31			0.29								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00								
Average Repair Time (Min Qty, Max Qty)	2.36E+01			3.80E+01			4.52E+01								
CV or beta (Min Qty, Max Qty)	0.46			0.39			0.39								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	8.3E+03	Normal	0.39	9.6E+03	Normal	0.39						
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.2E+05	Normal	0.39	1.7E+05	Normal	0.39						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		15%	0.50							

Comments:

This fragility is same as B1041.061. Closest match available.

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Laura Lowes

Revisions:

2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.093b

NISTIR Name

Non-conforming MF with weak joints and column flexural response, Conc Col & Bm = 36" x 36", Beam both sides

Description

Non-Conforming MF, joint shear failure, column flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam < 0.8, (2) [...TBD...], (3) Non-compliant column transverse reinforcement and or joint V/Vn > 1.2. Costing is on a per joint basis.

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

Columns exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinf.

Columns exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes column transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

Columns exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.

Quantity Rounding

Round Qty? YES

Allow sum by floor or building? NO

Demand Location (floor above?) No

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:

Fragility Parameters

Median Demand, θ :

0.015

0.0175

0.02

Data dispersion, β_d :

Not Specified

0.27

0.18

Uncertainty, β_u :

0.4

0.15

0.35

Total Dispersion, β :

0.4

0.4

Correlation (Yes / No)

NO

Data Quality Marginal

Documentation Quality Superior

Directionality (Yes / No)

YES

Data Relevance Average

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00								
Average Repair Cost (Min Qty, Max Qty)	2.68E+04			4.31E+04			5.12E+04								
CV or beta (Min Qty, Max Qty)	0.39			0.31			0.29								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00								
Average Repair Time (Min Qty, Max Qty)	2.36E+01			3.80E+01			4.52E+01								
CV or beta (Min Qty, Max Qty)	0.46			0.39			0.39								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	8.3E+03	Normal	0.39	9.6E+03	Normal	0.39						
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.2E+05	Normal	0.39	1.7E+05	Normal	0.39						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		15%	0.50							

Comments:

This fragility is same as B1041.061. Closest match available.

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Laura Lowes

Revisions:

2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR ClassificationB1041.101a

NISTIR NameNon-conforming MF, weak beams and strong joints, Conc Col & Bm = 24" x 24", Beam one side

DescriptionNon-Conforming MF, beam shear failure, beam flexural response. Meets the following requirements: (1) Beam with HIGH V/bwd(f'c)*0.5 or non-compliant transverse beam reinforcing. Costing is on a per joint basis.

Line 162

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Beams exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams exhibit residual crack widths > 0.06 in. Spalling of beam cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of beam core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

				
B1041.051a-DS1-1.JPG	B1041.051a-DS2-1.JPG	B1041.051a-DS3-1.JPG		
1.00	1.00	1.00		

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	0.015	0.02	0.025	
Data dispersion, β_d :	Not Specified	0.27	0.15	
Uncertainty, β_u :	0.4	0.15	0.35	
Total Dispersion, β :	0.4	0.4	0.4	
Correlation (Yes / No)	NO	Data Quality Marginal	Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Average	Rationality Superior	

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.85E+04	3.25E+04	4.44E+04	2.30E+04	4.00E+04	5.29E+04						
Best fit mean:	2.09E+04			3.18E+04			3.86E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00								
Average Repair Cost (Min Qty, Max Qty)	2.68E+04			4.06E+04			5.00E+04								
CV or beta (Min Qty, Max Qty)	0.39			0.32			0.30								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.63E+01	2.87E+01	3.92E+01	2.03E+01	3.53E+01	4.67E+01						
Best fit mean:	1.89E+01			2.87E+01			3.53E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00								
Average Repair Time (Min Qty, Max Qty)	2.36E+01			3.58E+01			4.41E+01								
CV or beta (Min Qty, Max Qty)	0.46			0.40			0.39								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	7.8E+03	Normal	0.40	9.4E+03	Normal	0.39						
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.1E+05	Normal	0.40	1.6E+05	Normal	0.39						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		25%	0.50							

Comments:None

Date Created:Not Given

Approved (YES / NO)?By User

Official (YES / NO) ?By User

Author:Laura Lowes

Revisions:2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier:1

Date Generated:02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1041.101b

Non-conforming MF, weak beams and strong joints, Conc Col & Bm = 24" x 24", Beam both sides

Non-Conforming MF, beam shear failure, beam flexural response. Meets the following requirements: (1) Beam with HIGH V/bwd(f'c)*0.5 or non-compliant transverse beam reinforcing. Costing is on a per joint basis.

Line 163

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

EA 1

Story Drift Ratio

3

DS1

Sequential

Seq(DS1,DS2,DS3)

Beams exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.

DS2

Sequential

Beams exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

DS3

Sequential

Beams exhibit residual crack widths > 0.06 in. Spalling of beam cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of beam core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations



B1041.051a-DS1-1.JPG

1.00



B1041.051a-DS2-1.JPG

1.00



B1041.051a-DS3-1.JPG

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

NO

YES

0.015

Not Specified

0.4

0.4

NO

YES

Data Quality

Data Relevance

Marginal

Average

Documentation Quality

Superior

Rationality

Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.02E+04

2.14E+04

3.11E+04

2.09E+04

Normal

5.00

20.00

2.68E+04

1.82E+04

4.06E+04

2.76E+04

5.00E+04

3.40E+04

0.39

0.39

Each

P₁₀

P₅₀

P₉₀

1.85E+04

3.25E+04

4.44E+04

3.18E+04

Normal

5.00

20.00

4.06E+04

2.76E+04

0.32

0.32

Each

P₁₀

P₅₀

P₉₀

2.30E+04

4.00E+04

5.29E+04

3.86E+04

Normal

5.00

20.00

5.00E+04

3.40E+04

0.30

0.30

Each

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

8.98E+00

1.89E+01

2.75E+01

1.89E+01

Normal

5.00

20.00

2.36E+01

1.61E+01

3.58E+01

2.44E+01

4.41E+01

3.00E+01

0.46

0.46

Each

P₁₀

P₅₀

P₉₀

1.63E+01

2.87E+01

3.92E+01

2.87E+01

Normal

5.00

20.00

3.58E+01

2.44E+01

0.40

0.40

Each

P₁₀

P₅₀

P₉₀

2.03E+01

3.53E+01

4.67E+01

3.53E+01

Normal

5.00

20.00

4.41E+01

3.00E+01

0.39

0.39

Each

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

4.9E+03

Normal

0.46

7.8E+03

Normal

0.40

9.4E+03

Normal

0.39

Median Cost

Best Fit

CV or Beta

7.3E+04

Normal

0.46

1.1E+05

Normal

0.40

1.6E+05

Normal

0.39

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

25%

0.50

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Laura Lowes

2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.102a

NISTIR Name

Non-conforming MF, weak beams and strong joints, Conc Col & Bm = 24" x 36", Beam one side

Description

Non-Conforming MF, beam shear failure, beam flexural response. Meets the following requirements: (1) Beam with HIGH V/bwd(f'c)*0.5 or non-compliant transverse beam reinforcing. Costing is on a per joint basis.

Line 164

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding Round Qty? YES

Allow sum by floor or building? NO

Demand Location (floor above?) No

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

Beams exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.

Beams exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

Beams exhibit residual crack widths > 0.06 in. Spalling of beam cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of beam core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.

Illustrations



Damage State Probability:

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.015

0.02

0.025

Data dispersion, β_d :

Not Specified

0.27

0.15

Uncertainty, β_u :

0.4

0.15

0.35

Total Dispersion, β :

0.4

0.4

0.4

Correlation (Yes / No)

NO

Data Quality Marginal

Documentation Quality Superior

Directionality (Yes / No)

YES

Data Relevance Average

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	2.68E+04 1.82E+04			4.31E+04 2.93E+04			5.12E+04 3.48E+04								
CV or beta (Min Qty, Max Qty)	0.39 0.39			0.31 0.31			0.29 0.29								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	2.36E+01 1.61E+01			3.80E+01 2.59E+01			4.52E+01 3.07E+01								
CV or beta (Min Qty, Max Qty)	0.46 0.46			0.39 0.39			0.39 0.39								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	8.3E+03	Normal	0.39	9.6E+03	Normal	0.39						
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.2E+05	Normal	0.39	1.7E+05	Normal	0.39						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			25% 0.50								

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Laura Lowes

Revisions:

2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.102b

NISTIR Name

Non-conforming MF, weak beams and strong joints, Conc Col & Bm = 24" x 36", Beam both sides

Description

Non-Conforming MF, beam shear failure, beam flexural response. Meets the following requirements: (1) Beam with HIGH V/bwd(f'c)*0.5 or non-compliant transverse beam reinforcing. Costing is on a per joint basis.

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding Round Qty? YES

Allow sum by floor or building? NO

Demand Location (floor above?) No

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

Beams exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.

Beams exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

Beams exhibit residual crack widths > 0.06 in. Spalling of beam cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of beam core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.

Illustrations



Damage State Probability:

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.015

0.02

0.025

Data dispersion, β_d :

Not Specified

0.27

0.15

Uncertainty, β_u :

0.4

0.15

0.35

Total Dispersion, β :

0.4

0.4

0.4

Correlation (Yes / No)

NO

Data Quality Marginal

Documentation Quality Superior

Directionality (Yes / No)

YES

Data Relevance Average

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	2.68E+04 1.82E+04			4.31E+04 2.93E+04			5.12E+04 3.48E+04								
CV or beta (Min Qty, Max Qty)	0.39 0.39			0.31 0.31			0.29 0.29								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	2.36E+01 1.61E+01			3.80E+01 2.59E+01			4.52E+01 3.07E+01								
CV or beta (Min Qty, Max Qty)	0.46 0.46			0.39 0.39			0.39 0.39								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	4.9E+03	Normal	0.46	8.3E+03	Normal	0.39	9.6E+03	Normal	0.39						
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.2E+05	Normal	0.39	1.7E+05	Normal	0.39						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			25% 0.50								

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Laura Lowes

Revisions:

2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR ClassificationB1041.103a

NISTIR NameNon-conforming MF, weak beams and strong joints, Conc Col & Bm = 36" x 36", Beam one side

DescriptionNon-Conforming MF, beam shear failure, beam flexural response. Meets the following requirements: (1) Beam with HIGH V/bwd(f'c)*0.5 or non-compliant transverse beam reinforcing. Costing is on a per joint basis.

Line 166

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Beams exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams exhibit residual crack widths > 0.06 in. Spalling of beam cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of beam core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.015	0.02	0.025		
Data dispersion, β_d :	Not Specified	0.27	0.15		
Uncertainty, β_u :	0.4	0.15	0.35		
Total Dispersion, β :	0.4	0.4	0.4		
Correlation (Yes / No)	NO	Data Quality Marginal		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Superior	

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	2.68E+04 1.82E+04			4.31E+04 2.93E+04			5.12E+04 3.48E+04								
CV or beta (Min Qty, Max Qty)	0.39 0.39			0.31 0.31			0.29 0.29								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	2.36E+01 1.61E+01			3.80E+01 2.59E+01			4.52E+01 3.07E+01								
CV or beta (Min Qty, Max Qty)	0.46 0.46			0.39 0.39			0.39 0.39								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	8.3E+03	Normal	0.39	9.6E+03	Normal	0.39						
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.2E+05	Normal	0.39	1.7E+05	Normal	0.39						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		25%	0.50							

Comments:None

Date Created:Not Given

Approved (YES / NO)?By User

Official (YES / NO) ?By User

Author:Laura Lowes

Revisions:2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier:1

Date Generated:02/26/19

FEMA P-58 Fragility Specification

NISTIR ClassificationB1041.103b

NISTIR NameNon-conforming MF, weak beams and strong joints, Conc Col & Bm = 36" x 36", Beam both sides

DescriptionNon-Conforming MF, beam shear failure, beam flexural response. Meets the following requirements: (1) Beam with HIGH V/bwd(f'c)*0.5 or non-compliant transverse beam reinforcing. Costing is on a per joint basis.

Line 167

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Beams exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams exhibit residual crack widths > 0.06 in. Spalling of beam cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of beam core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.015	0.02	0.025		
Data dispersion, β_d :	Not Specified	0.27	0.15		
Uncertainty, β_u :	0.4	0.15	0.35		
Total Dispersion, β :	0.4	0.4	0.4		
Correlation (Yes / No)	NO	Data Quality Marginal		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Superior	

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	2.68E+04 1.82E+04			4.31E+04 2.93E+04			5.12E+04 3.48E+04								
CV or beta (Min Qty, Max Qty)	0.39 0.39			0.31 0.31			0.29 0.29								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	2.36E+01 1.61E+01			3.80E+01 2.59E+01			4.52E+01 3.07E+01								
CV or beta (Min Qty, Max Qty)	0.46 0.46			0.39 0.39			0.39 0.39								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	8.3E+03	Normal	0.39	9.6E+03	Normal	0.39						
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.2E+05	Normal	0.39	1.7E+05	Normal	0.39						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		25%	0.50							

Comments:None

Date Created:Not Given

Approved (YES / NO)?By User

Official (YES / NO) ?By User

Author:Laura Lowes

Revisions:2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier:1

Date Generated:02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification
NISTIR Name
Description

B1041.111a
Non-conforming MF, weak columns, Conc Col & Bm = 24" x 24", Beam one side
Non-Conforming MF, column flexure-shear or shear failure, column flexural response. Meets the following requirements: (1) [...TBD...] Costing is on a per joint basis.

Line 168

Construction Quality:	Not Specified			
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Story Drift Ratio Unit less			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Columns exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Columns exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes column transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Columns exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

				
B1041.051a-DS1-1.JPG	B1041.051a-DS2-1.JPG	B1041.051a-DS3-1.JPG		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.015	0.02	0.025		
Data dispersion, β_d :	Not Specified	0.27	0.15		
Uncertainty, β_u :	0.4	0.15	0.35		
Total Dispersion, β :	0.4	0.4	0.4		
Correlation (Yes / No)	NO	Data Quality Marginal		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Superior	

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.85E+04	3.25E+04	4.44E+04	2.30E+04	4.00E+04	5.29E+04						
Best fit mean:	2.09E+04			3.18E+04			3.86E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00								
Average Repair Cost (Min Qty, Max Qty)	2.68E+04			4.06E+04			5.00E+04								
CV or beta (Min Qty, Max Qty)	0.39			0.32			0.30								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.63E+01	2.87E+01	3.92E+01	2.03E+01	3.53E+01	4.67E+01						
Best fit mean:	1.89E+01			2.87E+01			3.53E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00								
Average Repair Time (Min Qty, Max Qty)	2.36E+01			3.58E+01			4.41E+01								
CV or beta (Min Qty, Max Qty)	0.46			0.40			0.39								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	7.8E+03	Normal	0.40	9.4E+03	Normal	0.39						
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.1E+05	Normal	0.40	1.6E+05	Normal	0.39						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		10%	0.50							

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: 2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.111b

NISTIR Name

Non-conforming MF, weak columns, Conc Col & Bm = 24" x 24", Beam both sides

Description

Non-Conforming MF, column flexure-shear or shear failure, column flexural response. Meets the following requirements: (1) [...TBD...] Costing is on a per joint basis.

Line 169

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

Columns exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.

Columns exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes column transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

Columns exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.

Illustrations



Damage State Probability:

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.015

0.02

0.025

Data dispersion, β_d :

Not Specified

0.27

0.15

Uncertainty, β_u :

0.4

0.15

0.35

Total Dispersion, β :

0.4

0.4

0.4

Correlation (Yes / No)

NO

Data Quality Marginal

Documentation Quality Superior

Directionality (Yes / No)

YES

Data Relevance Average

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.85E+04	3.25E+04	4.44E+04	2.30E+04	4.00E+04	5.29E+04						
Best fit mean:	2.09E+04			3.18E+04			3.86E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	2.68E+04 1.82E+04			4.06E+04 2.76E+04			5.00E+04 3.40E+04								
CV or beta (Min Qty, Max Qty)	0.39 0.39			0.32 0.32			0.30 0.30								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.63E+01	2.87E+01	3.92E+01	2.03E+01	3.53E+01	4.67E+01						
Best fit mean:	1.89E+01			2.87E+01			3.53E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	2.36E+01 1.61E+01			3.58E+01 2.44E+01			4.41E+01 3.00E+01								
CV or beta (Min Qty, Max Qty)	0.46 0.46			0.40 0.40			0.39 0.39								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	7.8E+03	Normal	0.40	9.4E+03	Normal	0.39						
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.1E+05	Normal	0.40	1.6E+05	Normal	0.39						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			10% 0.50								

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Laura Lowes

Revisions:

2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.112a

NISTIR Name
Description

Non-conforming MF, weak columns, Conc Col & Bm = 24" x 36", Beam one side
Non-Conforming MF, column flexure-shear or shear failure, column flexural response. Meets the following requirements: (1) [...TBD...] Costing is on a per joint basis.

Line 170

Construction Quality:	Not Specified					<div>Quantity RoundingRound Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	EA 1					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	3					
Damage State:	DS1		DS2		DS3	
Type of Damage State:	Sequential		Sequential		Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)					
Descriptions	Columns exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.		Columns exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes column transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.		Columns exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.	

Illustrations

				
B1041.051a-DS1-1.JPG	B1041.051a-DS2-1.JPG	B1041.051a-DS3-1.JPG		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.015	0.02	0.025		
Data dispersion, β_d :	Not Specified	0.27	0.15		
Uncertainty, β_u :	0.4	0.15	0.35		
Total Dispersion, β :	0.4	0.4	0.4		
Correlation (Yes / No)	NO	Data Quality Marginal		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Superior	

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	2.68E+04 1.82E+04			4.31E+04 2.93E+04			5.12E+04 3.48E+04								
CV or beta (Min Qty, Max Qty)	0.39 0.39			0.31 0.31			0.29 0.29								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	2.36E+01 1.61E+01			3.80E+01 2.59E+01			4.52E+01 3.07E+01								
CV or beta (Min Qty, Max Qty)	0.46 0.46			0.39 0.39			0.39 0.39								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	8.3E+03	Normal	0.39	9.6E+03	Normal	0.39						
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.2E+05	Normal	0.39	1.7E+05	Normal	0.39						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			10% 0.50								

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: 2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.112b

NISTIR Name
Description

Non-conforming MF, weak columns, Conc Col & Bm = 24" x 36", Beam both sides
Non-Conforming MF, column flexure-shear or shear failure, column flexural response. Meets the following requirements: (1) [...TBD...] Costing is on a per joint basis.

Line 171

Construction Quality:	Not Specified			
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Story Drift Ratio Unit less			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Columns exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Columns exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes column transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Columns exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

				
B1041.051a-DS1-1.JPG	B1041.051a-DS2-1.JPG	B1041.051a-DS3-1.JPG		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, δ :	0.015	0.02	0.025		
Data dispersion, β_d :	Not Specified	0.27	0.15		
Uncertainty, β_u :	0.4	0.15	0.35		
Total Dispersion, β :	0.4	0.4	0.4		
Correlation (Yes / No)	NO	Data Quality Marginal	Documentation Quality Superior		
Directionality (Yes / No)	YES	Data Relevance Average	Rationality Superior		

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	2.68E+04 1.82E+04			4.31E+04 2.93E+04			5.12E+04 3.48E+04								
CV or beta (Min Qty, Max Qty)	0.39 0.39			0.31 0.31			0.29 0.29								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	2.36E+01 1.61E+01			3.80E+01 2.59E+01			4.52E+01 3.07E+01								
CV or beta (Min Qty, Max Qty)	0.46 0.46			0.39 0.39			0.39 0.39								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	8.3E+03	Normal	0.39	9.6E+03	Normal	0.39						
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.2E+05	Normal	0.39	1.7E+05	Normal	0.39						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		10%	0.50							

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: 2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.113a

NISTIR Name
Description

Non-conforming MF, weak columns, Conc Col & Bm = 36" x 36", Beam one side
Non-Conforming MF, column flexure-shear or shear failure, column flexural response. Meets the following requirements: (1) [...TBD...] Costing is on a per joint basis.

Line 172

Construction Quality:	Not Specified			
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Story Drift Ratio Unit less			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Columns exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Columns exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes column transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Columns exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

				
B1041.051a-DS1-1.JPG	B1041.051a-DS2-1.JPG	B1041.051a-DS3-1.JPG		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.015	0.02	0.025		
Data dispersion, β_d :	Not Specified	0.27	0.15		
Uncertainty, β_u :	0.4	0.15	0.35		
Total Dispersion, β :	0.4	0.4	0.4		
Correlation (Yes / No)	NO	Data Quality Marginal		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Superior	

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	2.68E+04 1.82E+04			4.31E+04 2.93E+04			5.12E+04 3.48E+04								
CV or beta (Min Qty, Max Qty)	0.39 0.39			0.31 0.31			0.29 0.29								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	2.36E+01 1.61E+01			3.80E+01 2.59E+01			4.52E+01 3.07E+01								
CV or beta (Min Qty, Max Qty)	0.46 0.46			0.39 0.39			0.39 0.39								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	8.3E+03	Normal	0.39	9.6E+03	Normal	0.39						
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.2E+05	Normal	0.39	1.7E+05	Normal	0.39						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			10% 0.50								

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: 2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.113b

NISTIR Name
Description

Non-conforming MF, weak columns, Conc Col & Bm = 36" x 36", Beam both sides
Non-Conforming MF, column flexure-shear or shear failure, column flexural response. Meets the following requirements: (1) [...TBD...] Costing is on a per joint basis.

Line 173

Construction Quality:	Not Specified					<div>Quantity RoundingRound Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	EA 1					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	3					
Damage State:	DS1	DS2	DS3			
Type of Damage State:	Sequential	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2,DS3)					
Descriptions	Columns exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Columns exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes column transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Columns exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.			

Illustrations

				
B1041.051a-DS1-1.JPG	B1041.051a-DS2-1.JPG	B1041.051a-DS3-1.JPG		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.015	0.02	0.025		
Data dispersion, β_d :	Not Specified	0.27	0.15		
Uncertainty, β_u :	0.4	0.15	0.35		
Total Dispersion, β :	0.4	0.4	0.4		
Correlation (Yes / No)	NO	Data Quality Marginal		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Superior	

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	2.68E+04 1.82E+04			4.31E+04 2.93E+04			5.12E+04 3.48E+04								
CV or beta (Min Qty, Max Qty)	0.39 0.39			0.31 0.31			0.29 0.29								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	2.36E+01 1.61E+01			3.80E+01 2.59E+01			4.52E+01 3.07E+01								
CV or beta (Min Qty, Max Qty)	0.46 0.46			0.39 0.39			0.39 0.39								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	8.3E+03	Normal	0.39	9.6E+03	Normal	0.39						
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.2E+05	Normal	0.39	1.7E+05	Normal	0.39						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			10% 0.50								

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: 2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1041.121a

Non-conforming MF, weak columns and strong joints, Conc Col & Bm = 24" x 24", Beam both sides

Non-Conforming MF, column flexure, flexure-shear, or shear failure, column flexural response. Meets the following requirements: (1) Column Pu > 0.6f'cAg, (2) Column Vn < Veq. Costing is on a per joint basis.

Line 174

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

EA 1

Story Drift Ratio

2

DS1

Sequential

Seq(DS1,DS2)


Concrete Cracking: beams, joints or possibly. Residual concrete crack widths exceed 0.06in. (1.5 mm). Column exhibits residual crack widths that require epoxy injection.

DS2


Sequential

Concrete Crushing: slabs, beams or joints. Spalling of beam, column or joint cover concrete exposes longitudinal reinforcement or strength loss initiates in laboratory testing. Exhibits concrete spalling that exposes longitudinal steel or crushing of core concrete.

Illustrations



B1041.071a-DS1-2.JPG



B1041.071a-DS2-1.JPG

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.00

0.0025

Not Specified

0.4

0.4

NO

YES

Data Quality

Data Relevance

Marginal

Average

Documentation Quality

Superior

Rationality

Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	2.45E+04	4.05E+04	5.34E+04									
Best fit mean:	2.09E+04			3.95E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00											
Average Repair Cost (Min Qty, Max Qty)	2.68E+04			5.06E+04											
CV or beta (Min Qty, Max Qty)	0.39			0.29											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	2.16E+01	3.57E+01	4.72E+01									
Best fit mean:	1.89E+01			3.57E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00											
Average Repair Time (Min Qty, Max Qty)	2.36E+01			4.46E+01											
CV or beta (Min Qty, Max Qty)	0.46			0.38											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	4.9E+03	Normal	0.46	9.7E+03	Normal	0.38									
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.4E+05	Normal	0.38									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		10%	0.50										

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Laura Lowes

2011-08-24 Negative probability below 0.1% drift - overlap deemed acceptable.

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.121b

NISTIR Name

Non-conforming MF, weak columns and strong joints, Conc Col & Bm = 24" x 24", Beam one side

Description

Non-Conforming MF, column flexure, flexure-shear, or shear failure, column flexural response. Meets the following requirements: (1) Column $P_u > 0.6f_cA_g$, (2) Column $V_n < V_{eq}$ Costing is on a per joint basis.

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Concrete Cracking: beams, joints or possibly. Residual concrete crack widths exceed 0.06in. (1.5 mm). Column exhibits residual crack widths that require epoxy injection.

Concrete Crushing: slabs, beams or joints. Spalling of beam, column or joint cover concrete exposes longitudinal reinforcement or strength loss initiates in laboratory testing. Exhibits concrete spalling that exposes longitudinal steel or crushing of core concrete.

Quantity Rounding

Round Qty? YES

Allow sum by floor or building? NO

Demand Location (floor above?) No

Illustrations



Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.0025

0.005

Data dispersion, β_d :

Not Specified

Not Specified

Uncertainty, β_u :

0.4

0.5

Total Dispersion, β :

0.4

0.5

Correlation (Yes / No)

NO

Data Quality Marginal

Documentation Quality Superior

Directionality (Yes / No)

YES

Data Relevance Average

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	2.45E+04	4.05E+04	5.34E+04									
Best fit mean:	2.09E+04			3.95E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00											
Average Repair Cost (Min Qty, Max Qty)	2.68E+04			5.06E+04											
CV or beta (Min Qty, Max Qty)	0.39			0.29											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	2.16E+01	3.57E+01	4.72E+01									
Best fit mean:	1.89E+01			3.57E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00											
Average Repair Time (Min Qty, Max Qty)	2.36E+01			4.46E+01											
CV or beta (Min Qty, Max Qty)	0.46			0.38											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	4.9E+03	Normal	0.46	9.7E+03	Normal	0.38									
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.4E+05	Normal	0.38									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%			0%											
Loss of Life (Median, Dispersion)	0%			0%											
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%			10%											

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Laura Lowes

Revisions:

2011-08-24 Negative probability below 0.1% drift - overlap deemed acceptable.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.122a

NISTIR Name

Non-conforming MF, weak columns and strong joints, Conc Col & Bm = 24" x 36", Beam one side

Description

Non-Conforming MF, column flexure, flexure-shear, or shear failure, column flexural response. Meets the following requirements: (1) Column Pu > 0.6f'cAg, (2) Column Vn < Veq Costing is on a per joint basis.

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Concrete Cracking: beams, joints or possibly. Residual concrete crack widths exceed 0.06in. (1.5 mm). Column exhibits residual crack widths that require epoxy injection.

Concrete Crushing: slabs, beams or joints. Spalling of beam, column or joint cover concrete exposes longitudinal reinforcement or strength loss initiates in laboratory testing. Exhibits concrete spalling that exposes longitudinal steel or crushing of core concrete.

Quantity Rounding

Round Qty? YES

Allow sum by floor or building? NO

Demand Location (floor above?) No

Illustrations



Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.0025

0.005

Data dispersion, β_d :

Not Specified

Not Specified

Uncertainty, β_u :

0.4

0.5

Total Dispersion, β :

0.4

0.5

Correlation (Yes / No)

NO

Data Quality Marginal

Documentation Quality Superior

Directionality (Yes / No)

YES

Data Relevance Average

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	2.55E+04	4.15E+04	5.44E+04									
Best fit mean:	2.09E+04			4.05E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00											
Average Repair Cost (Min Qty, Max Qty)	2.68E+04			5.19E+04											
CV or beta (Min Qty, Max Qty)	0.39			0.28											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	2.25E+01	3.66E+01	4.80E+01									
Best fit mean:	1.89E+01			3.66E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00											
Average Repair Time (Min Qty, Max Qty)	2.36E+01			4.58E+01											
CV or beta (Min Qty, Max Qty)	0.46			0.37											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	4.9E+03	Normal	0.46	9.9E+03	Normal	0.37									
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.4E+05	Normal	0.37									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%			0%											
Loss of Life (Median, Dispersion)	0%			0%											
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%			10%											

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Laura Lowes

Revisions:

2011-08-24 Negative probability below 0.1% drift - overlap deemed acceptable.

Line 176

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.122b

NISTIR Name

Non-conforming MF, weak columns and strong joints, Conc Col & Bm = 24" x 36", Beam both sides

Description

Non-Conforming MF, column flexure, flexure-shear, or shear failure, column flexural response. Meets the following requirements: (1) Column Pu > 0.6f'cAg, (2) Column Vn < Veq Costing is on a per joint basis.

Line 177

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding Round Qty? YES

Allow sum by floor or building? NO

Demand Location (floor above?) No

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Concrete Cracking: beams, joints or possibly. Residual concrete crack widths exceed 0.06in. (1.5 mm). Column exhibits residual crack widths that require epoxy injection.

Concrete Crushing: slabs, beams or joints. Spalling of beam, column or joint cover concrete exposes longitudinal reinforcement or strength loss initiates in laboratory testing. Exhibits concrete spalling that exposes longitudinal steel or crushing of core concrete.

Illustrations



Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.0025

0.005

Data dispersion, β_d :

Not Specified

Not Specified

Uncertainty, β_u :

0.4

0.5

Total Dispersion, β :

0.4

0.5

Correlation (Yes / No)

NO

Data Quality Marginal

Documentation Quality Superior

Directionality (Yes / No)

YES

Data Relevance Average

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	2.55E+04	4.15E+04	5.44E+04									
Best fit mean:	2.09E+04			4.05E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00											
Average Repair Cost (Min Qty, Max Qty)	2.68E+04			5.19E+04											
CV or beta (Min Qty, Max Qty)	0.39			0.28											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	2.25E+01	3.66E+01	4.80E+01									
Best fit mean:	1.89E+01			3.66E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00											
Average Repair Time (Min Qty, Max Qty)	2.36E+01			4.58E+01											
CV or beta (Min Qty, Max Qty)	0.46			0.37											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	9.9E+03	Normal	0.37									
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.4E+05	Normal	0.37									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		10%	0.50										

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Laura Lowes

Revisions:

2011-08-24 Negative probability below 0.1% drift - overlap deemed acceptable.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1041.123a

Non-conforming MF, weak columns and strong joints, Conc Col & Bm = 36" x 36", Beam one side

Non-Conforming MF, column flexure, flexure-shear, or shear failure, column flexural response. Meets the following requirements: (1) Column Pu > 0.6f'cAg, (2) Column Vn < Veq. Costing is on a per joint basis.

Line 178

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

EA 1

Story Drift Ratio

2

DS1

Sequential

Seq(DS1,DS2)


Concrete Cracking: beams, joints or possibly. Residual concrete crack widths exceed 0.06in. (1.5 mm). Column exhibits residual crack widths that require epoxy injection.

DS2


Sequential

Concrete Crushing: slabs, beams or joints. Spalling of beam, column or joint cover concrete exposes longitudinal reinforcement or strength loss initiates in laboratory testing. Exhibits concrete spalling that exposes longitudinal steel or crushing of core concrete.

Illustrations



B1041.071a-DS1-2.JPG



B1041.071a-DS2-1.JPG

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.00

1.00

0.0025

Not Specified

0.4

0.4

NO

YES

Data Quality

Data Relevance

Marginal

Average

Documentation Quality

Superior

Rationality

Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	2.55E+04	4.15E+04	5.44E+04									
Best fit mean:	2.09E+04			4.05E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00											
Average Repair Cost (Min Qty, Max Qty)	2.68E+04			5.19E+04											
CV or beta (Min Qty, Max Qty)	0.39			0.28											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	2.25E+01	3.66E+01	4.80E+01									
Best fit mean:	1.89E+01			3.66E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00											
Average Repair Time (Min Qty, Max Qty)	2.36E+01			4.58E+01											
CV or beta (Min Qty, Max Qty)	0.46			0.37											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	4.9E+03	Normal	0.46	9.9E+03	Normal	0.37									
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.4E+05	Normal	0.37									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		10%	0.50										

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Laura Lowes

2011-08-24 Negative probability below 0.1% drift - overlap deemed acceptable.

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1041.123b

Non-conforming MF, weak columns and strong joints, Conc Col & Bm = 36" x 36", Beam both sides

Non-Conforming MF, column flexure, flexure-shear, or shear failure, column flexural response. Meets the following requirements: (1) Column Pu > 0.6f'cAg, (2) Column Vn < Veq. Costing is on a per joint basis.

Line 179

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

EA 1

Story Drift Ratio

2

DS1

Sequential

Seq(DS1,DS2)


Concrete Cracking: beams, joints or possibly. Residual concrete crack widths exceed 0.06in. (1.5 mm). Column exhibits residual crack widths that require epoxy injection.

DS2


Sequential

Concrete Crushing: slabs, beams or joints. Spalling of beam, column or joint cover concrete exposes longitudinal reinforcement or strength loss initiates in laboratory testing. Exhibits concrete spalling that exposes longitudinal steel or crushing of core concrete.

Illustrations



B1041.071a-DS1-2.JPG



B1041.071a-DS2-1.JPG

Damage State Probability:

Fragility Parameters

Median Demand, θ:

Data dispersion, β_d:

Uncertainty, β_u:

Total Dispersion, β:

Correlation (Yes / No)

Directionality (Yes / No)

1.00

0.0025

Not Specified

0.4

0.4

NO

YES

Data Quality

Data Relevance

Marginal

Average

Documentation Quality

Superior

Rationality

Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	2.55E+04	4.15E+04	5.44E+04									
Best fit mean:	2.09E+04			4.05E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00			20.00											
Average Repair Cost (Min Qty, Max Qty)	2.68E+04			5.19E+04											
CV or beta (Min Qty, Max Qty)	0.39			0.28											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	2.25E+01	3.66E+01	4.80E+01									
Best fit mean:	1.89E+01			3.66E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00			20.00											
Average Repair Time (Min Qty, Max Qty)	2.36E+01			4.58E+01											
CV or beta (Min Qty, Max Qty)	0.46			0.37											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	9.9E+03	Normal	0.37									
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.4E+05	Normal	0.37									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%			0%											
Loss of Life (Median, Dispersion)	0%			0%											
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%			10%											

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Laura Lowes

2011-08-24 Negative probability below 0.1% drift - overlap deemed acceptable.

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.131a

Line 180

NISTIR Name
Description

Non-conforming MF with inadequate development of reinforcing, Conc Col & Bm = 24" x 24", Beam one side
Non-Conforming MF, non-ductile failure, non-ductile response. May exhibit the following: (1) Splice detailing or length inadequate per ASCE 41-06 Table 6-7iii, (2) Beam or column reinforcing spliced at the face of joint, (3) Beam longitudinal steel discontinuous through joint per ASCE41-06 Table 6-7iii. Costing is on a per joint basis.

Construction Quality:	Not Specified					Quantity RoundingRound Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	EA 1					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Damage is concentrated in beams, columns or joints depending on location of non-compliant detail. Beams, columns or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.		Damage is concentrated in beams, columns or joints depending on location of non-compliant detail. Beams, columns or joints exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinf. requiring replacement may occur.			

Illustrations

none	none			
1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.015	0.02			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	0.4	0.4			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO	Data Quality Marginal	Documentation Quality Superior		
Directionality (Yes / No)	YES	Data Relevance Average	Rationality Superior		

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀			
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	2.45E+04	4.05E+04	5.34E+04												
Best fit mean:	2.09E+04			3.95E+04														
Best Fit Distribution:	Normal			Normal														
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			20.00											
Average Repair Cost (Min Qty, Max Qty)	2.68E+04			1.82E+04			5.06E+04			3.44E+04								
CV or beta (Min Qty, Max Qty)	0.39			0.39			0.29			0.29								
Quantity Unit:	Each			Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀			
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	2.16E+01	3.57E+01	4.72E+01												
Best fit mean:	1.89E+01			3.57E+01														
Best Fit Distribution:	Normal			Normal														
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			20.00											
Average Repair Time (Min Qty, Max Qty)	2.36E+01			1.61E+01			4.46E+01			3.04E+01								
CV or beta (Min Qty, Max Qty)	0.46			0.46			0.38			0.38								
Quantity Unit:	Each			Each														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta			
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	9.7E+03	Normal	0.38												
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.4E+05	Normal	0.38												
LifeSafety Hazard:																		
Potential non-collapse casualties? (Yes / No)	NO						NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable						Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00						0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00						0% 0.00											
Post-event Tagging Flag:	NO						YES											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00						10% 0.50											

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: None

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.131b

Line 181

NISTIR Name
Description

Non-conforming MF with inadequate development of reinforcing, Conc Col & Bm = 24" x 24", Beam both sides
Non-Conforming MF, non-ductile failure, non-ductile response. May exhibit the following: (1) Splice detailing or length inadequate per ASCE 41-06 Table 6-7iii, (2) Beam or column reinforcing spliced at the face of joint, (3) Beam longitudinal steel discontinuous through joint per ASCE41-06 Table 6-7iii. Costing is on a per joint basis.

Construction Quality:	Not Specified					Quantity Rounding Round Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	EA 1					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Damage is concentrated in beams, columns or joints depending on location of non-compliant detail. Beams, columns or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.		Damage is concentrated in beams, columns or joints depending on location of non-compliant detail. Beams, columns or joints exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinf. requiring replacement may occur.			
Illustrations						
	none		none			
Damage State Probability:	1.00		1.00			
Fragility Parameters						
Median Demand, θ :	0.015		0.02			
Data dispersion, β_d :	Not Specified		Not Specified			
Uncertainty, β_u :	0.4		0.4			
Total Dispersion, β :	0.4		0.4			
Correlation (Yes / No)	NO		Data Quality Marginal		Documentation Quality Superior	
Directionality (Yes / No)	YES		Data Relevance Average		Rationality Superior	

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	2.45E+04	4.05E+04	5.34E+04									
Best fit mean:	2.09E+04			3.95E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00											
Average Repair Cost (Min Qty, Max Qty)	2.68E+04			5.06E+04											
CV or beta (Min Qty, Max Qty)	0.39			0.29											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	2.16E+01	3.57E+01	4.72E+01									
Best fit mean:	1.89E+01			3.57E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00											
Average Repair Time (Min Qty, Max Qty)	2.36E+01			4.46E+01											
CV or beta (Min Qty, Max Qty)	0.46			0.38											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	9.7E+03	Normal	0.38									
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.4E+05	Normal	0.38									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		10%	0.50										

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: None

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.132a

Line 182

NISTIR Name
Description

Non-conforming MF with inadequate development of reinforcing, Conc Col & Bm = 24" x 36", Beam one side
Non-Conforming MF, non-ductile failure, non-ductile response. May exhibit the following: (1) Splice detailing or length inadequate per ASCE 41-06 Table 6-7iii, (2) Beam or column reinforcing spliced at the face of joint, (3) Beam longitudinal steel discontinuous through joint per ASCE41-06 Table 6-7iii. Costing is on a per joint basis.

Construction Quality:	Not Specified				<table><tr><td>Quantity Rounding</td><td>Round Qty?</td><td>YES</td></tr><tr><td>Allow sum by floor or building?</td><td>NO</td><td>NO</td></tr><tr><td>Demand Location (floor above?)</td><td>NO</td><td>NO</td></tr></table>		Quantity Rounding	Round Qty?	YES	Allow sum by floor or building?	NO	NO	Demand Location (floor above?)	NO	NO
Quantity Rounding	Round Qty?	YES													
Allow sum by floor or building?	NO	NO													
Demand Location (floor above?)	NO	NO													
Seismic Installation Conditions:	Not Specified														
Fragility Unit of Measure:	EA 1														
Demand Parameter (unit):	Story Drift Ratio														
Number of Damage States:	2														
Damage State:	DS1		DS2												
Type of Damage State:	Sequential		Sequential												
DS Hierarchy	Seq(DS1,DS2)														
Descriptions	Damage is concentrated in beams, columns or joints depending on location of non-compliant detail. Beams, columns or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.		Damage is concentrated in beams, columns or joints depending on location of non-compliant detail. Beams, columns or joints exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinf. requiring replacement may occur.												
Illustrations	<table><tr><td></td><td></td><td></td><td></td><td></td></tr></table>														
Damage State Probability:	none		none												
	1.00		1.00												
Fragility Parameters															
Median Demand, θ :	0.015		0.02												
Data dispersion, β_d :	Not Specified		Not Specified												
Uncertainty, β_u :	0.4		0.4												
Total Dispersion, β :	0.4		0.4												
Correlation (Yes / No)	NO		Data Quality Marginal		Documentation Quality Superior										
Directionality (Yes / No)	YES		Data Relevance Average		Rationality Superior										

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	2.55E+04	4.15E+04	5.44E+04									
Best fit mean:	2.09E+04			4.05E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00											
Average Repair Cost (Min Qty, Max Qty)	2.68E+04			5.19E+04											
CV or beta (Min Qty, Max Qty)	0.39			0.28											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	2.25E+01	3.66E+01	4.80E+01									
Best fit mean:	1.89E+01			3.66E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00											
Average Repair Time (Min Qty, Max Qty)	2.36E+01			4.58E+01											
CV or beta (Min Qty, Max Qty)	0.46			0.37											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	9.9E+03	Normal	0.37									
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.4E+05	Normal	0.37									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%			0%											
Loss of Life (Median, Dispersion)	0%			0%											
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%			10%											

Comments:

None

Date Created:
Approved (YES / NO)?
Official (YES / NO) ?
Author:
Revisions:

Not Given
By User
By User
Laura Lowes
None

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.132b

Line 183

NISTIR Name
Description

Non-conforming MF with inadequate development of reinforcing, Conc Col & Bm = 24" x 36", Beam both sides
Non-Conforming MF, non-ductile failure, non-ductile response. May exhibit the following: (1) Splice detailing or length inadequate per ASCE 41-06 Table 6-7iii, (2) Beam or column reinforcing spliced at the face of joint, (3) Beam longitudinal steel discontinuous through joint per ASCE41-06 Table 6-7iii. Costing is on a per joint basis.

Construction Quality:	Not Specified		<table><tr><td>Quantity Rounding</td><td>Round Qty?</td><td>YES</td></tr><tr><td>Allow sum by floor or building?</td><td>NO</td><td>NO</td></tr><tr><td>Demand Location (floor above?)</td><td>NO</td><td>NO</td></tr></table>			Quantity Rounding	Round Qty?	YES	Allow sum by floor or building?	NO	NO	Demand Location (floor above?)	NO	NO
Quantity Rounding	Round Qty?	YES												
Allow sum by floor or building?	NO	NO												
Demand Location (floor above?)	NO	NO												
Seismic Installation Conditions:	Not Specified													
Fragility Unit of Measure:	EA 1													
Demand Parameter (unit):	Story Drift Ratio		Unit less											
Number of Damage States:	2													
Damage State:	DS1		DS2											
Type of Damage State:	Sequential		Sequential											
DS Hierarchy	Seq(DS1,DS2)													
Descriptions	Damage is concentrated in beams, columns or joints depending on location of non-compliant detail. Beams, columns or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.		Damage is concentrated in beams, columns or joints depending on location of non-compliant detail. Beams, columns or joints exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinf. requiring replacement may occur.											
Illustrations	<table><tr><td></td><td></td><td></td><td></td><td></td></tr></table>													
Damage State Probability:	none		none											
	1.00		1.00											
Fragility Parameters														
Median Demand, θ :	0.015		0.02											
Data dispersion, β_d :	Not Specified		Not Specified											
Uncertainty, β_u :	0.4		0.4											
Total Dispersion, β :	0.4		0.4											
Correlation (Yes / No)	NO		Data Quality Marginal											
Directionality (Yes / No)	YES		Data Relevance Average											
			Documentation Quality Superior											
			Rationality Superior											

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	2.55E+04	4.15E+04	5.44E+04									
Best fit mean:	2.09E+04			4.05E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00											
Average Repair Cost (Min Qty, Max Qty)	2.68E+04			5.19E+04											
CV or beta (Min Qty, Max Qty)	0.39			0.28											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	2.25E+01	3.66E+01	4.80E+01									
Best fit mean:	1.89E+01			3.66E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00											
Average Repair Time (Min Qty, Max Qty)	2.36E+01			4.58E+01											
CV or beta (Min Qty, Max Qty)	0.46			0.37											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	9.9E+03	Normal	0.37									
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.4E+05	Normal	0.37									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%			0%											
Loss of Life (Median, Dispersion)	0%			0%											
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%			10%											

Comments:
Date Created:
Approved (YES / NO)?
Official (YES / NO) ?
Author:
Revisions:

None
Not Given
By User
By User
Laura Lowes
None

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.133a

Line 184

NISTIR Name
Description

Non-conforming MF with inadequate development of reinforcing, Conc Col & Bm = 36" x 36", Beam one side
Non-Conforming MF, non-ductile failure, non-ductile response. May exhibit the following: (1) Splice detailing or length inadequate per ASCE 41-06 Table 6-7iii, (2) Beam or column reinforcing spliced at the face of joint, (3) Beam longitudinal steel discontinuous through joint per ASCE41-06 Table 6-7iii. Costing is on a per joint basis.

Construction Quality:	Not Specified							
Seismic Installation Conditions:	Not Specified							
Fragility Unit of Measure:	EA 1		<div>Quantity RoundingRound Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No</div>					
Demand Parameter (unit):	Story Drift RatioUnit less							
Number of Damage States:	2							
Damage State:	DS1	DS2						
Type of Damage State:	Sequential		Sequential					
DS Hierarchy	Seq(DS1,DS2)							
Descriptions	Damage is concentrated in beams, columns or joints depending on location of non-compliant detail. Beams, columns or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.		Damage is concentrated in beams, columns or joints depending on location of non-compliant detail. Beams, columns or joints exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinf. requiring replacement may occur.					
Illustrations								
	none	none						
Damage State Probability:	1.00	1.00						
Fragility Parameters								
Median Demand, θ :	0.015	0.02						
Data dispersion, β_d :	Not Specified	Not Specified						
Uncertainty, β_u :	0.4	0.4						
Total Dispersion, β :	0.4	0.4						
Correlation (Yes / No)	NO	Data Quality Marginal		Documentation Quality Superior				
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Superior				

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	2.55E+04	4.15E+04	5.44E+04									
Best fit mean:	2.09E+04			4.05E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00											
Average Repair Cost (Min Qty, Max Qty)	2.68E+04			5.19E+04											
CV or beta (Min Qty, Max Qty)	0.39			0.28											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	2.25E+01	3.66E+01	4.80E+01									
Best fit mean:	1.89E+01			3.66E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00											
Average Repair Time (Min Qty, Max Qty)	2.36E+01			4.58E+01											
CV or beta (Min Qty, Max Qty)	0.46			0.37											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	9.9E+03	Normal	0.37									
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.4E+05	Normal	0.37									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		10%	0.50										

Comments:
Date Created:
Approved (YES / NO)?
Official (YES / NO) ?
Author:
Revisions:

None
Not Given
By User
By User
Laura Lowes
None

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.133b

Line 185

NISTIR Name
Description

Non-conforming MF with inadequate development of reinforcing, Conc Col & Bm = 36" x 36", Beam both sides
Non-Conforming MF, non-ductile failure, non-ductile response. May exhibit the following: (1) Splice detailing or length inadequate per ASCE 41-06 Table 6-7iii, (2) Beam or column reinforcing spliced at the face of joint, (3) Beam longitudinal steel discontinuous through joint per ASCE41-06 Table 6-7iii. Costing is on a per joint basis.

Construction Quality:
Seismic Installation Conditions:

Not Specified
Not Specified

Fragility Unit of Measure:	EA 1
Demand Parameter (unit):	Story Drift Ratio
Number of Damage States:	2

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Damage State:	DS1	DS2			
Type of Damage State:	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Damage is concentrated in beams, columns or joints depending on location of non-compliant detail. Beams, columns or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Damage is concentrated in beams, columns or joints depending on location of non-compliant detail. Beams, columns or joints exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinf. requiring replacement may occur.			

Illustrations

none	none			
1.00	1.00			

Damage State Probability:

Fragility Parameters				
Median Demand, θ :	0.015	0.02		
Data dispersion, β_d :	Not Specified	Not Specified		
Uncertainty, β_u :	0.4	0.4		
Total Dispersion, β :	0.4	0.4		

Correlation (Yes / No) NO Data Quality Marginal Documentation Quality Superior
Directionality (Yes / No) YES Data Relevance Average Rationality Superior

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	2.55E+04	4.15E+04	5.44E+04									
Best fit mean:	2.09E+04			4.05E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00											
Average Repair Cost (Min Qty, Max Qty)	2.68E+04			5.19E+04											
CV or beta (Min Qty, Max Qty)	0.39			0.28											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	2.25E+01	3.66E+01	4.80E+01									
Best fit mean:	1.89E+01			3.66E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00											
Average Repair Time (Min Qty, Max Qty)	2.36E+01			4.58E+01											
CV or beta (Min Qty, Max Qty)	0.46			0.37											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.46	9.9E+03	Normal	0.37									
Embodied Energy (MJ)	7.3E+04	Normal	0.46	1.4E+05	Normal	0.37									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		10%	0.50										

Comments:

None

Date Created:
Approved (YES / NO)?
Official (YES / NO) ?
Author:
Revisions:

Not Given
By User
By User
Laura Lowes
None

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1042.001a

NISTIR Name
Description

Concrete link beam, diagonally reinforced, aspect ratio between 1.0 and 2.0, beam < 16" wide and depth < 30"
None

Line 240

Construction Quality: Not Specified
Seismic Installation Conditions: Not applicable

Fragility Unit of Measure:	EA 1
Demand Parameter (unit):	Link Beam Chord Rotation Radians
Number of Damage States:	3

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	No	

Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Residual cracks no greater than 1/16 inch. Cracks are mainly at the beam to wall interface, some limited flexural cracking.	Residual cracks greater than 1/8 inch and minor spalling of concrete.	Significant strength degradation (<0.8Vn), buckling or fracture of diagonal reinforcing, crushing of concrete.		

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.0179	0.0352	0.0543		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified		
Total Dispersion, β :	0.38	0.44	0.95		
Correlation (Yes / No)	NO	Data Quality Not Rated	Documentation Quality Not Rated		
Directionality (Yes / No)	YES	Data Relevance Not Rated	Rationality Not Rated		

Consequence Functions
Repair Description

Epoxy inject cracks (200 to 240 inches in length).

Epoxy inject cracks (600 to 720 inches) and slab (300 inches), replace spalled concrete.

Chip away damaged concrete, attached mechanical couplers to the diagonal bars still embedded in the wall, replace damaged or fractured reinforcing. Replace damaged concrete.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	9.86E+03	1.29E+04	2.62E+04	1.39E+04	2.84E+04	3.93E+04	2.23E+04	4.44E+04	5.97E+04						
Best fit mean:	1.46E+04			2.72E+04			4.21E+04								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	1.55E+04 1.03E+04			3.41E+04 2.28E+04			5.33E+04 3.55E+04								
CV or beta (Min Qty, Max Qty)	0.44 0.44			0.36 0.36			0.35 0.35								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.41E+00	1.10E+01	2.23E+01	1.18E+01	2.43E+01	3.35E+01	1.90E+01	3.79E+01	5.09E+01						
Best fit mean:	1.10E+01			2.43E+01			3.79E+01								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	1.32E+01 8.81E+00			2.91E+01 1.94E+01			4.54E+01 3.03E+01								
CV or beta (Min Qty, Max Qty)	0.50 0.50			0.44 0.44			0.43 0.43								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.3E+03	LogNormal	0.50	5.3E+03	Normal	0.44	9.8E+03	Normal	0.43						
Embodied Energy (MJ)	3.2E+04	LogNormal	0.50	7.2E+04	Normal	0.44	1.7E+05	Normal	0.43						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		25%	0.50							

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: John Wallace
Revisions: None

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1042.001b

Concrete link beam, diagonally reinforced, aspect ratio between 2.0 and 4.0, beam < 16" wide and depth < 30"

None

Line 241

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not applicable

EA 1

Link Beam Chord Rotation

3

DS1

Sequential

Seq(DS1,DS2,DS3)

Residual cracks no greater than 1/16 inch. Cracks are mainly at the beam to wall interface, some limited flexural cracking.

DS2

Sequential

Residual cracks greater than 1/8 inch and minor spalling of concrete.

DS3

Sequential

Significant strength degradation (<0.8Vn), buckling or fracture of diagonal reinforcing, crushing of concrete.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.00

0.0203

Not Specified

Not Specified

0.39

NO

YES

Data Quality

Not Rated

Data Relevance

Not Rated

Documentation Quality

Not Rated

Rationality

Not Rated

Consequence Functions

Repair Description

Epoxy inject cracks (200 to 240 inches in length).

Epoxy inject cracks (600 to 720 inches) and slab (300 inches), replace spalled concrete.

Chip away damaged concrete, attached mechanical couplers to the diagonal bars still embedded in the wall, replace damaged or fractured reinforcing. Replace damaged concrete.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Time:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

8.13E+03

1.06E+04

2.44E+04

P₁₀

P₅₀

P₉₀

1.39E+04

2.78E+04

3.93E+04

P₁₀

P₅₀

P₉₀

2.01E+04

4.16E+04

5.90E+04

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.24E+04

LogNormal

5.00

20.00

2.70E+04

Normal

5.00

20.00

4.02E+04

Normal

5.00

20.00

1.27E+04

0.52

8.46E+03

0.52

3.34E+04

0.37

2.23E+04

0.37

4.99E+04

0.38

3.33E+04

0.38

Each

Each

Each

P₁₀

P₅₀

P₉₀

6.93E+00

9.02E+00

2.08E+01

P₁₀

P₅₀

P₉₀

1.18E+01

2.37E+01

3.35E+01

P₁₀

P₅₀

P₉₀

1.71E+01

3.55E+01

5.03E+01

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

9.02E+00

LogNormal

5.00

20.00

2.37E+01

Normal

5.00

20.00

3.55E+01

Normal

5.00

20.00

1.08E+01

0.57

7.22E+00

0.57

2.85E+01

0.44

1.90E+01

0.44

4.25E+01

0.45

2.84E+01

0.45

Each

Each

Each

Median Cost

Best Fit

CV or Beta

8.1E+02

LogNormal

0.57

Median Cost

Best Fit

CV or Beta

5.3E+03

Normal

0.44

Median Cost

Best Fit

CV or Beta

8.5E+03

Normal

0.45

1.9E+04

LogNormal

0.57

7.2E+04

Normal

0.44

1.5E+05

Normal

0.45

NO

NO

NO

Not Applicable

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

0%

0.00

NO

NO

YES

0%

0.00

0%

0.00

25%

0.50

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

John Wallace

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1042.002a

NISTIR Name
Description

Concrete link beam, conventionally reinforced, aspect ratio between 1.0 and 2.0, beam < 16" wide and depth < 30"
None

Line 242

Construction Quality: Not Specified
Seismic Installation Conditions: Not applicable

Fragility Unit of Measure:	EA 1
Demand Parameter (unit):	Link Beam Chord Rotation Radians
Number of Damage States:	3

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Residual cracks no greater than 1/16 inch. Cracks are mainly at the beam to wall interface, some limited flexural cracking.	Residual cracks greater than 1/8 inch and minor spalling of concrete.	Significant strength degradation (<0.8Vn), buckling or fracture of diagonal reinforcing, crushing of concrete.		

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.0137	0.0264	0.0428		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified		
Total Dispersion, β :	0.21	0.33	0.74		
Correlation (Yes / No)	NO	Data Quality Not Rated	Documentation Quality Not Rated		
Directionality (Yes / No)	YES	Data Relevance Not Rated	Rationality Not Rated		

Consequence Functions
Repair Description

Epoxy inject cracks (200 to 240 inches in length).

Epoxy inject cracks (600 to 720 inches) and slab (300 inches), replace spalled concrete.

Chip away damaged concrete, attached mechanical couplers to the diagonal bars still embedded in the wall, replace damaged or fractured reinforcing. Replace damaged concrete.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	9.86E+03	1.29E+04	2.62E+04	1.39E+04	2.84E+04	3.93E+04	2.23E+04	4.44E+04	5.97E+04						
Best fit mean:	1.46E+04			2.72E+04			4.21E+04								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	1.55E+04 1.03E+04			3.41E+04 2.28E+04			5.33E+04 3.55E+04								
CV or beta (Min Qty, Max Qty)	0.44 0.44			0.36 0.36			0.35 0.35								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.41E+00	1.10E+01	2.23E+01	1.18E+01	2.43E+01	3.35E+01	1.90E+01	3.79E+01	5.09E+01						
Best fit mean:	1.10E+01			2.43E+01			3.79E+01								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	1.32E+01 8.81E+00			2.91E+01 1.94E+01			4.54E+01 3.03E+01								
CV or beta (Min Qty, Max Qty)	0.50 0.50			0.44 0.44			0.43 0.43								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.3E+03	LogNormal	0.50	5.3E+03	Normal	0.44	9.8E+03	Normal	0.43						
Embodied Energy (MJ)	3.2E+04	LogNormal	0.50	7.2E+04	Normal	0.44	1.7E+05	Normal	0.43						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		25%	0.50							

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: John Wallace
Revisions: None

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification B1042.002b

NISTIR Name Concrete link beam, conventionally reinforced, aspect ratio between 2.0 and 4.0, beam < 16" wide and depth < 30"

Description None

Line 243

Construction Quality:	Not Specified				
Seismic Installation Conditions:	Not applicable				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Link Beam Chord Rotation Radians				
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Residual cracks no greater than 1/16 inch. Cracks are mainly at the beam to wall interface, some limited flexural cracking.	Residual cracks greater than 1/8 inch and minor spalling of concrete.	Significant strength degradation (<0.8Vn), buckling or fracture of diagonal reinforcing, crushing of concrete.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.0137	0.0264	0.0407		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified		
Total Dispersion, β :	0.21	0.33	0.75		
Correlation (Yes / No)	NO	Data Quality Not Rated	Documentation Quality Not Rated		
Directionality (Yes / No)	YES	Data Relevance Not Rated	Rationality Not Rated		

Consequence Functions

Repair Description

Epoxy inject cracks (200 to 240 inches in length).

Epoxy inject cracks (600 to 720 inches) and slab (300 inches), replace spalled concrete.

Chip away damaged concrete, attached mechanical couplers to the diagonal bars still embedded in the wall, replace damaged or fractured reinforcing. Replace damaged concrete.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	8.13E+03	1.06E+04	2.44E+04	1.39E+04	2.78E+04	3.93E+04	2.01E+04	4.16E+04	5.90E+04						
Best fit mean:	1.24E+04			2.70E+04			4.02E+04								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	1.27E+04 8.46E+03			3.34E+04 2.23E+04			4.99E+04 3.33E+04								
CV or beta (Min Qty, Max Qty)	0.52 0.52			0.37 0.37			0.38 0.38								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	6.93E+00	9.02E+00	2.08E+01	1.18E+01	2.37E+01	3.35E+01	1.71E+01	3.55E+01	5.03E+01						
Best fit mean:	9.02E+00			2.37E+01			3.55E+01								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	1.08E+01 7.22E+00			2.85E+01 1.90E+01			4.25E+01 2.84E+01								
CV or beta (Min Qty, Max Qty)	0.57 0.57			0.44 0.44			0.45 0.45								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	8.1E+02	LogNormal	0.57	5.3E+03	Normal	0.44	8.5E+03	Normal	0.45						
Embodied Energy (MJ)	1.9E+04	LogNormal	0.57	7.2E+04	Normal	0.44	1.5E+05	Normal	0.45						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		25%	0.50							

Comments: None

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: John Wallace

Revisions: None

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1042.011a

Concrete link beam, diagonally reinforced, aspect ratio between 1.0 and 2.0, beam > 16" wide and depth < 30"

None

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not applicable

EA 1

Link Beam Chord Rotation

3

DS1

Sequential

Seq(DS1,DS2,DS3)

Residual cracks no greater than 1/16 inch. Cracks are mainly at the beam to wall interface, some limited flexural cracking.

DS2

Sequential

Not Specified

Residual cracks greater than 1/8 inch and minor spalling of concrete.

DS3

Sequential

Not Specified

Significant strength degradation (<0.8Vn), buckling or fracture of diagonal reinforcing, crushing of concrete.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

none

none

none

Damage State Probability:

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

NO

YES

Data Quality

Not Rated

Documentation Quality

Not Rated

Data Relevance

Not Rated

Rationality

Not Rated

Consequence Functions

Repair Description

Epoxy inject cracks (200 to 240 inches in length).

Epoxy inject cracks (600 to 720 inches) and slab (300 inches), replace spalled concrete.

Chip away damaged concrete, attached mechanical couplers to the diagonal bars still embedded in the wall, replace damaged or fractured reinforcing. Replace damaged concrete.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

9.86E+03

1.29E+04

2.62E+04

1.46E+04

LogNormal

5.00

20.00

1.55E+04

1.03E+04

0.44

0.44

Each

P₁₀

P₅₀

P₉₀

1.49E+04

2.94E+04

4.03E+04

2.82E+04

Normal

5.00

20.00

3.53E+04

2.36E+04

0.35

0.35

Each

P₁₀

P₅₀

P₉₀

2.33E+04

4.54E+04

6.07E+04

4.31E+04

Normal

5.00

20.00

5.45E+04

3.63E+04

0.34

0.34

Each

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

8.41E+00

1.10E+01

2.23E+01

1.10E+01

LogNormal

5.00

20.00

1.32E+01

8.81E+00

0.50

0.50

Each

P₁₀

P₅₀

P₉₀

1.27E+01

2.51E+01

3.43E+01

2.51E+01

Normal

5.00

20.00

3.01E+01

2.01E+01

0.43

0.43

Each

P₁₀

P₅₀

P₉₀

1.99E+01

3.87E+01

5.18E+01

3.87E+01

Normal

5.00

20.00

4.65E+01

3.10E+01

0.42

0.42

Each

Environmental Impacts:

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Embodied Carbon (kg CO2eq)

1.3E+03

LogNormal

0.50

5.4E+03

Normal

0.43

1.0E+04

Normal

0.42

Embodied Energy (MJ)

3.2E+04

LogNormal

0.50

7.5E+04

Normal

0.43

1.8E+05

Normal

0.42

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

Not Applicable

0%

0.00

25%

0.50

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

John Wallace

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1042.011b

NISTIR Name

Concrete link beam, diagonally reinforced, aspect ratio between 2.0 and 4.0, beam > 16" wide and depth < 30"

Line 245

Construction Quality:	Not Specified
Seismic Installation Conditions:	Not applicable

Seismic Installation Conditions:	Not applicable	
Fragility Unit of Measure:	EA 1	
Demand Parameter (unit):	Link Beam Chord Rotation	Radians
Number of Damage States:	3	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Number of Damage States:		3	
Damage State:	DS1	DS2	DS3

Type of Damage State:	Sequential	Sequential	Sequential
DS Hierarchy	Seq(DS1,DS2,DS3)		
Descriptions	Residual cracks no greater than 1/16 inch. Cracks are mainly at the beam to wall interface, some limited flexural cracking.	Residual cracks greater than 1/8 inch and minor spalling of concrete.	Significant strength degradation (<0.8Vn), buckling or fracture of diagonal reinforcing, crushing of concrete.

Illustrations

none	none	none		

Damage State Probability:

Damage State Probability:	1.00	1.00	1.00
Fragility Parameters			
Median Demand, θ :	0.0203	0.0394	0.0602
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified
Total Dispersion, β :	0.39	0.35	1

Total Dispersion, σ :		0.39	0.33	1	
Correlation (Yes / No)	NO		Data Quality Not Rated		Documentation Quality Not Rated
Directionality (Yes / No)	YES		Data Relevance Not Rated		Rationality Not Rated

Consequence Functions

Repair Description

Epoxy inject cracks (200 to 240 inches in length).	Epoxy inject cracks (600 to 720 inches) and slab (300 inches), replace spalled concrete.	Chip away damaged concrete, attached mechanical couplers to the diagonal bars still embedded in the wall, replace damaged or fractured reinforcing. Replace damaged concrete.
--	--	---

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	8.13E+03	1.06E+04	2.44E+04	1.49E+04	2.88E+04	4.03E+04	2.11E+04	4.26E+04	6.00E+04						
Best fit mean:	1.24E+04			2.80E+04			4.12E+04								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	1.27E+04 8.46E+03			3.46E+04 2.31E+04			5.11E+04 3.41E+04								
CV or beta (Min Qty, Max Qty)	0.52 0.52			0.35 0.35			0.37 0.37								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	6.93E+00	9.02E+00	2.08E+01	1.27E+01	2.46E+01	3.43E+01	1.80E+01	3.63E+01	5.12E+01						
Best fit mean:	9.02E+00			2.46E+01			3.63E+01								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	1.08E+01 7.22E+00			2.95E+01 1.97E+01			4.36E+01 2.90E+01								
CV or beta (Min Qty, Max Qty)	0.57 0.57			0.43 0.43			0.45 0.45								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	8.1E+02	LogNormal	0.57	5.4E+03	Normal	0.43	8.7E+03	Normal	0.45						
Embodied Energy (MJ)	1.9E+04	LogNormal	0.57	7.5E+04	Normal	0.43	1.6E+05	Normal	0.45						
LifeSafety Hazard:	Potential non-collapse casualties? (Yes / No)			Potential non-collapse casualties? (Yes / No)			Potential non-collapse casualties? (Yes / No)			Potential non-collapse casualties? (Yes / No)			Potential non-collapse casualties? (Yes / No)		
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable			Not Applicable		
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00			0% 0.00		
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00			0% 0.00		
Post-event Tagging Flag:	NO			NO			YES			YES			YES		
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			25% 0.50			25% 0.50			25% 0.50		

Comments:	None
Date Created:	Not Given
Approved (YES / NO)?	By User
Official (YES / NO) ?	By User
Author:	John Wallace
Revisions:	None

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1042.012a

NISTIR Name
Description

Concrete link beam, conventionally reinforced, aspect ratio between 1.0 and 2.0, beam > 16" wide and depth < 30"
None

Line 246

Construction Quality: Not Specified
Seismic Installation Conditions: Not applicable

Fragility Unit of Measure:	EA 1
Demand Parameter (unit):	Link Beam Chord Rotation Radians
Number of Damage States:	3

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Residual cracks no greater than 1/16 inch. Cracks are mainly at the beam to wall interface, some limited flexural cracking.	Residual cracks greater than 1/8 inch and minor spalling of concrete.	Significant strength degradation (<0.8Vn), buckling or fracture of diagonal reinforcing, crushing of concrete.		

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.0137	0.0264	0.0428		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified		
Total Dispersion, β :	0.21	0.33	0.74		
Correlation (Yes / No)	NO	Data Quality Not Rated	Documentation Quality Not Rated		
Directionality (Yes / No)	YES	Data Relevance Not Rated	Rationality Not Rated		

Consequence Functions
Repair Description

Epoxy inject cracks (200 to 240 inches in length).

Epoxy inject cracks (600 to 720 inches) and slab (300 inches), replace spalled concrete.

Chip away damaged concrete, attached mechanical couplers to the diagonal bars still embedded in the wall, replace damaged or fractured reinforcing. Replace damaged concrete.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	9.86E+03	1.29E+04	2.62E+04	1.49E+04	2.94E+04	4.03E+04	2.33E+04	4.54E+04	6.07E+04						
Best fit mean:	1.46E+04			2.82E+04			4.31E+04								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	1.55E+04 1.03E+04			3.53E+04 2.36E+04			5.45E+04 3.63E+04								
CV or beta (Min Qty, Max Qty)	0.44 0.44			0.35 0.35			0.34 0.34								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.41E+00	1.10E+01	2.23E+01	1.27E+01	2.51E+01	3.43E+01	1.99E+01	3.87E+01	5.18E+01						
Best fit mean:	1.10E+01			2.51E+01			3.87E+01								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	1.32E+01 8.81E+00			3.01E+01 2.01E+01			4.65E+01 3.10E+01								
CV or beta (Min Qty, Max Qty)	0.50 0.50			0.43 0.43			0.42 0.42								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.3E+03	LogNormal	0.50	5.4E+03	Normal	0.43	1.0E+04	Normal	0.42						
Embodied Energy (MJ)	3.2E+04	LogNormal	0.50	7.5E+04	Normal	0.43	1.8E+05	Normal	0.42						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		25%	0.50							

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: John Wallace
Revisions: None

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR ClassificationB1042.012b

NISTIR NameConcrete link beam, conventionally reinforced, aspect ratio between 2.0 and 4.0, beam > 16" wide and depth < 30"

DescriptionNone

Line 247

Construction Quality:	Not Specified				
Seismic Installation Conditions:	Not applicable				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Link Beam Chord Rotation Radians				
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Residual cracks no greater than 1/16 inch. Cracks are mainly at the beam to wall interface, some limited flexural cracking.	Residual cracks greater than 1/8 inch and minor spalling of concrete.	Significant strength degradation (<0.8Vn), buckling or fracture of diagonal reinforcing, crushing of concrete.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.0137	0.0264	0.0407		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified		
Total Dispersion, β :	0.21	0.33	0.75		
Correlation (Yes / No)	NO	Data Quality Not Rated	Documentation Quality Not Rated		
Directionality (Yes / No)	YES	Data Relevance Not Rated	Rationality Not Rated		

Consequence Functions
Repair Description

Epoxy inject cracks (200 to 240 inches in length).	Epoxy inject cracks (600 to 720 inches) and slab (300 inches), replace spalled concrete.	Chip away damaged concrete, attached mechanical couplers to the diagonal bars still embedded in the wall, replace damaged or fractured reinforcing. Replace damaged concrete.
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Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	8.13E+03	1.06E+04	2.44E+04	1.49E+04	2.88E+04	4.03E+04	2.11E+04	4.26E+04	6.00E+04						
Best fit mean:	1.24E+04			2.80E+04			4.12E+04								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	1.27E+04 8.46E+03			3.46E+04 2.31E+04			5.11E+04 3.41E+04								
CV or beta (Min Qty, Max Qty)	0.52 0.52			0.35 0.35			0.37 0.37								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	6.93E+00	9.02E+00	2.08E+01	1.27E+01	2.46E+01	3.43E+01	1.80E+01	3.63E+01	5.12E+01						
Best fit mean:	9.02E+00			2.46E+01			3.63E+01								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	1.08E+01 7.22E+00			2.95E+01 1.97E+01			4.36E+01 2.90E+01								
CV or beta (Min Qty, Max Qty)	0.57 0.57			0.43 0.43			0.45 0.45								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	8.1E+02	LogNormal	0.57	5.4E+03	Normal	0.43	8.7E+03	Normal	0.45						
Embodied Energy (MJ)	1.9E+04	LogNormal	0.57	7.5E+04	Normal	0.43	1.6E+05	Normal	0.45						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		25%	0.50							

Comments:None

Date Created:Not Given

Approved (YES / NO)?By User

Official (YES / NO) ?By User

Author:John Wallace

Revisions:None

Root Cost Multiplier:1

Date Generated:02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1042.021a

Concrete link beam, diagonally reinforced, aspect ratio between 1.0 and 2.0, beam > 24" wide and depth < 30"

None

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not applicable

EA 1

Link Beam Chord Rotation

3

DS1

Sequential

Seq(DS1,DS2,DS3)

Residual cracks no greater than 1/16 inch. Cracks are mainly at the beam to wall interface, some limited flexural cracking.

DS2

Sequential

Not Specified

Residual cracks greater than 1/8 inch and minor spalling of concrete.

DS3

Sequential

Not Specified

Significant strength degradation (<0.8Vn), buckling or fracture of diagonal reinforcing, crushing of concrete.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

none

none

none

Damage State Probability:

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

NO

YES

Data Quality

Not Rated

Documentation Quality

Not Rated

Data Relevance

Not Rated

Rationality

Not Rated

Consequence Functions

Repair Description

Epoxy inject cracks (200 to 240 inches in length).

Epoxy inject cracks (600 to 720 inches) and slab (300 inches), replace spalled concrete.

Chip away damaged concrete, attached mechanical couplers to the diagonal bars still embedded in the wall, replace damaged or fractured reinforcing. Replace damaged concrete.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

9.86E+03

1.29E+04

2.62E+04

1.46E+04

LogNormal

5.00

20.00

1.55E+04

1.03E+04

0.44

0.44

Each

P₁₀

P₅₀

P₉₀

1.49E+04

2.94E+04

4.03E+04

2.82E+04

Normal

5.00

20.00

3.53E+04

2.36E+04

0.35

0.35

Each

P₁₀

P₅₀

P₉₀

2.33E+04

4.64E+04

6.07E+04

4.35E+04

Normal

5.00

20.00

5.57E+04

3.71E+04

0.34

0.34

Each

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

8.41E+00

1.10E+01

2.23E+01

1.10E+01

LogNormal

5.00

20.00

1.32E+01

8.81E+00

0.50

0.50

Each

P₁₀

P₅₀

P₉₀

1.27E+01

2.51E+01

3.43E+01

2.51E+01

Normal

5.00

20.00

3.01E+01

2.01E+01

0.43

0.43

Each

P₁₀

P₅₀

P₉₀

1.99E+01

3.96E+01

5.18E+01

3.96E+01

Normal

5.00

20.00

4.75E+01

3.17E+01

0.42

0.42

Each

Environmental Impacts:

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Embodied Carbon (kg CO2eq)

1.3E+03

LogNormal

0.50

5.4E+03

Normal

0.43

1.0E+04

Normal

0.42

Embodied Energy (MJ)

3.2E+04

LogNormal

0.50

7.5E+04

Normal

0.43

1.8E+05

Normal

0.42

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

Not Applicable

0%

0.00

25%

0.50

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

John Wallace

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR ClassificationB1042.021b

NISTIR NameConcrete link beam, diagonally reinforced, aspect ratio between 2.0 and 4.0, beam > 24" wide and depth < 30"

DescriptionNone

Line 249

Construction Quality:	Not Specified				
Seismic Installation Conditions:	Not applicable				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Link Beam Chord Rotation Radians				
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Residual cracks no greater than 1/16 inch. Cracks are mainly at the beam to wall interface, some limited flexural cracking.	Residual cracks greater than 1/8 inch and minor spalling of concrete.	Significant strength degradation (<0.8Vn), buckling or fracture of diagonal reinforcing, crushing of concrete.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.0203	0.0394	0.0602		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified		
Total Dispersion, β :	0.39	0.35	1		
Correlation (Yes / No)	NO	Data Quality Not Rated	Documentation Quality Not Rated		
Directionality (Yes / No)	YES	Data Relevance Not Rated	Rationality Not Rated		

Consequence Functions
Repair Description

Epoxy inject cracks (200 to 240 inches in length).

Epoxy inject cracks (600 to 720 inches) and slab (300 inches), replace spalled concrete.

Chip away damaged concrete, attached mechanical couplers to the diagonal bars still embedded in the wall, replace damaged or fractured reinforcing. Replace damaged concrete.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	8.13E+03	1.06E+04	2.44E+04	1.49E+04	2.88E+04	4.03E+04	2.11E+04	4.36E+04	6.00E+04						
Best fit mean:	1.24E+04			2.80E+04			4.15E+04								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	1.27E+04 8.46E+03			3.46E+04 2.31E+04			5.23E+04 3.49E+04								
CV or beta (Min Qty, Max Qty)	0.52 0.52			0.35 0.35			0.37 0.37								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	6.93E+00	9.02E+00	2.08E+01	1.27E+01	2.46E+01	3.43E+01	1.80E+01	3.72E+01	5.12E+01						
Best fit mean:	9.02E+00			2.46E+01			3.72E+01								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	1.08E+01 7.22E+00			2.95E+01 1.97E+01			4.46E+01 2.97E+01								
CV or beta (Min Qty, Max Qty)	0.57 0.57			0.43 0.43			0.44 0.44								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	8.1E+02	LogNormal	0.57	5.4E+03	Normal	0.43	8.9E+03	Normal	0.44						
Embodied Energy (MJ)	1.9E+04	LogNormal	0.57	7.5E+04	Normal	0.43	1.6E+05	Normal	0.44						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		25%	0.50							

Comments:None

Date Created:Not Given

Approved (YES / NO)?By User

Official (YES / NO) ?By User

Author:John Wallace

Revisions:None

Root Cost Multiplier:1

Date Generated:02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1042.022a

Concrete link beam, conventionally reinforced, aspect ratio between 1.0 and 2.0, beam > 24" wide and depth < 30"

None

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not applicable

EA 1

Link Beam Chord Rotation

3

DS1

Sequential

Seq(DS1,DS2,DS3)

Residual cracks no greater than 1/16 inch. Cracks are mainly at the beam to wall interface, some limited flexural cracking.

DS2

Sequential

Residual cracks greater than 1/8 inch and minor spalling of concrete.

DS3

Sequential

Significant strength degradation (<0.8Vn), buckling or fracture of diagonal reinforcing, crushing of concrete.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

none

1.00

none

1.00

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Data Quality

Data Relevance

Not Rated

Documentation Quality

Not Rated

Rationality

Not Rated

Consequence Functions

Repair Description

Epoxy inject cracks (200 to 240 inches in length).

Epoxy inject cracks (600 to 720 inches) and slab (300 inches), replace spalled concrete.

Chip away damaged concrete, attached mechanical couplers to the diagonal bars still embedded in the wall, replace damaged or fractured reinforcing. Replace damaged concrete.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO₂eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

John Wallace

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification B1042.022b

NISTIR Name Concrete link beam, conventionally reinforced, aspect ratio between 2.0 and 4.0, beam > 24" wide and depth < 30"

Description None

Line 251

Construction Quality:	Not Specified				
Seismic Installation Conditions:	Not applicable				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Link Beam Chord Rotation Radians				
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Residual cracks no greater than 1/16 inch. Cracks are mainly at the beam to wall interface, some limited flexural cracking.	Residual cracks greater than 1/8 inch and minor spalling of concrete.	Significant strength degradation (<0.8Vn), buckling or fracture of diagonal reinforcing, crushing of concrete.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.0137	0.0264	0.0407		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified		
Total Dispersion, β :	0.21	0.33	0.75		
Correlation (Yes / No)	NO	Data Quality Not Rated	Documentation Quality Not Rated		
Directionality (Yes / No)	YES	Data Relevance Not Rated	Rationality Not Rated		

Consequence Functions

Repair Description

Epoxy inject cracks (200 to 240 inches in length).

Epoxy inject cracks (600 to 720 inches) and slab (300 inches), replace spalled concrete.

Chip away damaged concrete, attached mechanical couplers to the diagonal bars still embedded in the wall, replace damaged or fractured reinforcing. Replace damaged concrete.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	8.13E+03	1.06E+04	2.44E+04	1.49E+04	2.88E+04	4.03E+04	2.11E+04	4.36E+04	6.00E+04						
Best fit mean:	1.24E+04			2.80E+04			4.15E+04								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	1.27E+04 8.46E+03			3.46E+04 2.31E+04			5.23E+04 3.49E+04								
CV or beta (Min Qty, Max Qty)	0.52 0.52			0.35 0.35			0.37 0.37								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	6.93E+00	9.02E+00	2.08E+01	1.27E+01	2.46E+01	3.43E+01	1.80E+01	3.72E+01	5.12E+01						
Best fit mean:	9.02E+00			2.46E+01			3.72E+01								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	1.08E+01 7.22E+00			2.95E+01 1.97E+01			4.46E+01 2.97E+01								
CV or beta (Min Qty, Max Qty)	0.57 0.57			0.43 0.43			0.44 0.44								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	8.1E+02	LogNormal	0.57	5.4E+03	Normal	0.43	8.9E+03	Normal	0.44						
Embodied Energy (MJ)	1.9E+04	LogNormal	0.57	7.5E+04	Normal	0.43	1.6E+05	Normal	0.44						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		25%	0.50							

Comments: None

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: John Wallace

Revisions: None

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1044.001

NISTIR Name
Description

Rectangular low aspect ratio concrete walls 8" or less thick single curtain up to 15' high
Costing for each 144 ft^2 Wall Panel, Orthogonal web reinforcement, f'c > 2500 psi, P/(A*f'c) <= 0.2

Line 186

Construction Quality:	Not Specified					<div>Quantity RoundingRound Qty?NO</div> <div>Allow sum by floor or building?NO</div> <div>Demand Location (floor above?)No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	SF 144					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	3					
Damage State:	DS1		DS2		DS3	
Type of Damage State:	Sequential		Sequential		Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)					
Descriptions	Cracks with maximum widths greater than 0.04 in but less than 0.12 in.		Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.		Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.	

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, δ :	0.0055	0.0109	0.013		
Data dispersion, β_δ :	0.35	0.27	0.35		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.36	0.3	0.36		
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Superior	

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

(1) Relocate office eqpt & furniture within 6 ft. of wall, both sides. Install protective covers on floor finishes & adjacent curtain wall system. (2) Remove arch: finishes on wall, both sides. (3) Relocate MEP systems within 6 ft. of wall. (4) Prepare & inject grout 330 ft. of crack per 100 ft2 of wall. (5) Remove 15 ft2 per 100 ft2 of wall & 10 1-ft. long sections of #8 buckled vert. rebar. (6) Replace buckled rebar with new rebar; attach to exposed ends of (E) rebar with mech splices; provide 8 #4 seismic ties at 4 in. oc, ea end of wall; re-bend 16 horiz. rebar in wall around new rebar. (7) Install formwork & cast 5ksi concrete into pockets cut in step 5. (8) Strip forms, clean-up, reinstall/return office eqpt., finishes, furniture & MEP.

(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft lengths. (5) Install bars: a. 12#9 A706 bars in bz ea. end; mech splices to (E); b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/fdr at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt, finishes, furniture & MEP.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	4.61E+03	5.18E+03	7.10E+03	1.05E+04	1.22E+04	1.57E+04	2.02E+04	2.29E+04	2.90E+04						
Best fit mean:	5.53E+03			1.26E+04			2.38E+04								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Cost (Min Qty, Max Qty)	6.48E+03			1.53E+04			2.86E+04								
CV or beta (Min Qty, Max Qty)	0.18			0.16			0.15								
Quantity Unit:	144 ft^2 Units			144 ft^2 Units			144 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	3.59E+00	4.05E+00	5.54E+00	8.19E+00	9.53E+00	1.22E+01	1.58E+01	1.79E+01	2.26E+01						
Best fit mean:	4.05E+00			9.53E+00			1.79E+01								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Time (Min Qty, Max Qty)	5.06E+00			1.19E+01			2.23E+01								
CV or beta (Min Qty, Max Qty)	0.31			0.30			0.29								
Quantity Unit:	144 ft^2 Units			144 ft^2 Units			144 ft^2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.5E+03	LogNormal	0.31	4.0E+03	LogNormal	0.30	5.7E+03	LogNormal	0.29						
Embodied Energy (MJ)	3.5E+04	LogNormal	0.31	7.7E+04	LogNormal	0.30	1.1E+05	LogNormal	0.29						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%			0%			0%								
Loss of Life (Median, Dispersion)	0%			0%			0%								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%			50%			25%								

Comments: Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Andrew Whittaker

Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.

Root Cost Multiplier: 144

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification B1044.002

NISTIR Name Rectangular low aspect ratio concrete walls 8" or less thick single curtain 16' high to 24' high

Description Costing for each 400 ft^2 Wall Panel, Orthogonal web reinforcement, f'c > 2500 psi, P/(A*f'c) <= 0.2

Line 187

Construction Quality:	Not Specified					<div>Quantity RoundingRound Qty?NO</div> <div>Allow sum by floor or building?NO</div> <div>Demand Location (floor above?)No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	SF 400					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	3					
Damage State:	DS1	DS2	DS3			
Type of Damage State:	Sequential	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2,DS3)					
Descriptions	Cracks with maximum widths greater than 0.04 in but less than 0.12 in.	Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.	Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.			

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, δ :	0.0055	0.0109	0.013		
Data dispersion, β_d :	0.35	0.27	0.35		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.36	0.3	0.36		
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Superior	

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

(1) Relocate office eqpt & furniture within 6 ft. of wall, both sides. Install protective covers on floor finishes & adjacent curtain wall system. (2) Remove arch: finishes on wall, both sides. (3) Relocate MEP systems within 6 ft. of wall. (4) Prepare & inject grout 330 ft. of crack per 100 ft2 of wall. (5) Remove 15 ft2 per 100 ft2 of wall & 10 1-ft. long sections of #8 buckled vert. rebar. (6) Replace buckled rebar with new rebar; attach to exposed ends of (E) rebar with mech splices; provide 8 #4 seismic ties at 4 in. oc, ea end of wall; re-bend 16 horiz. rebar in wall around new rebar. (7) Install formwork & cast 5ksi concrete into pockets cut in step 5. (8) Strip forms, clean-up, reinstall/return office eqpt., finishes, furniture & MEP.

(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft lengths. (5) Install bars: a. 12#9 A706 bars in bz ea. end; mech splices to (E); b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/fdr at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt, finishes, furniture & MEP.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.44E+04	1.64E+04	1.96E+04	3.32E+04	3.72E+04	4.48E+04	5.32E+04	6.03E+04	7.67E+04						
Best fit mean:	1.67E+04			3.81E+04			6.26E+04								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Cost (Min Qty, Max Qty)	2.05E+04			4.65E+04			7.54E+04								
CV or beta (Min Qty, Max Qty)	0.12			0.12			0.15								
Quantity Unit:	400 ft^2 Units			400 ft^2 Units			400 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.34E+01	1.52E+01	1.82E+01	3.07E+01	3.44E+01	4.15E+01	4.93E+01	5.59E+01	7.10E+01						
Best fit mean:	1.52E+01			3.44E+01			5.59E+01								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Time (Min Qty, Max Qty)	1.90E+01			4.30E+01			6.99E+01								
CV or beta (Min Qty, Max Qty)	0.28			0.28			0.29								
Quantity Unit:	400 ft^2 Units			400 ft^2 Units			400 ft^2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.1E+03	LogNormal	0.28	1.3E+04	LogNormal	0.28	1.6E+04	LogNormal	0.29						
Embodied Energy (MJ)	9.7E+04	LogNormal	0.28	2.6E+05	LogNormal	0.28	3.0E+05	LogNormal	0.29						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%			0%			0%								
Loss of Life (Median, Dispersion)	0%			0%			0%								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%			50%			25%								

Comments: Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Andrew Whittaker

Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.

Root Cost Multiplier: 400

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1044.003

NISTIR Name
Description

Rectangular low aspect ratio concrete walls 8" or less thick single curtain 25' high to 40' high
Costing for each 900 ft^2 Wall Panel, Orthogonal web reinforcement, f'c > 2500 psi, P/(A*f'c) <= 0.2

Line 188

Construction Quality:	Not Specified					Quantity Rounding Round Qty? NO Allow sum by floor or building? NO Demand Location (floor above?) No
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	SF 900					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	3					
Damage State:	DS1		DS2		DS3	
Type of Damage State:	Sequential		Sequential		Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)					
Descriptions	Cracks with maximum widths greater than 0.04 in but less than 0.12 in.		Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.		Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.	

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, δ :	0.0055	0.0109	0.013		
Data dispersion, β_d :	0.35	0.27	0.35		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.36	0.3	0.36		
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Superior	

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

(1) Relocate office eqpt & furniture within 6 ft. of wall, both sides. Install protective covers on floor finishes & adjacent curtain wall system. (2) Remove arch: finishes on wall, both sides. (3) Relocate MEP systems within 6 ft. of wall. (4) Prepare & inject grout 330 ft. of crack per 100 ft2 of wall. (5) Remove 15 ft2 per 100 ft2 of wall & 10 1-ft. long sections of #8 buckled vert. rebar. (6) Replace buckled rebar with new rebar; attach to exposed ends of (E) rebar with mech splices; provide 8 #4 seismic ties at 4 in. oc, ea end of wall; re-bend 16 horiz. rebar in wall around new rebar. (7) Install formwork & cast 5ksi concrete into pockets cut in step 5. (8) Strip forms, clean-up, reinstall/return office eqpt., finishes, furniture & MEP.

(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft lengths. (5) Install bars: a. 12#9 A706 bars in bz ea. end; mech splices to (E); b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/fdr at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in., with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt, finishes, furniture & MEP.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.14E+04	3.42E+04	4.19E+04	7.36E+04	7.90E+04	9.16E+04	1.00E+05	1.19E+05	1.48E+05						
Best fit mean:	3.56E+04 LogNormal			8.11E+04 LogNormal			1.21E+05 LogNormal								
Best Fit Distribution:	3.00			3.00			3.00								
Quantity Plateau (Min Qty, Max Qty)	4.28E+04			9.88E+04			1.48E+05								
Average Repair Cost (Min Qty, Max Qty)	0.12			0.09			0.15								
CV or beta (Min Qty, Max Qty)	0.12			0.09			0.15								
Quantity Unit:	900 ft^2 Units			900 ft^2 Units			900 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	3.00E+01	3.27E+01	4.01E+01	7.04E+01	7.56E+01	8.76E+01	9.58E+01	1.13E+02	1.41E+02						
Best fit mean:	3.27E+01 LogNormal			7.56E+01 LogNormal			1.13E+02 LogNormal								
Best Fit Distribution:	3.00			3.00			3.00								
Quantity Plateau (Min Qty, Max Qty)	4.08E+01			9.45E+01			1.42E+02								
Average Repair Time (Min Qty, Max Qty)	0.28			0.26			0.29								
CV or beta (Min Qty, Max Qty)	0.28			0.26			0.29								
Quantity Unit:	900 ft^2 Units			900 ft^2 Units			900 ft^2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	9.1E+03	LogNormal	0.28	2.8E+04	LogNormal	0.26	3.3E+04	LogNormal	0.29						
Embodied Energy (MJ)	2.2E+05	LogNormal	0.28	5.6E+05	LogNormal	0.26	6.0E+05	LogNormal	0.29						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		50%	0.50		25%	0.50							

Comments: Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Andrew Whittaker

Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.

Root Cost Multiplier: 900

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification B1044.011

NISTIR Name Rectangular low aspect ratio concrete walls 8"-16" double curtain; with heights of up to 15'

Description Costing for each 144 ft^2 Wall Panel, Orthogonal web reinforcement, f'c > 2500 psi, P/(A*f'c) <= 0.2

Line 189

Construction Quality:	Not Specified					<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	SF 144					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	3					
Damage State:	DS1	DS2	DS3			
Type of Damage State:	Sequential	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2,DS3)					
Descriptions	Cracks with maximum widths greater than 0.04 in but less than 0.12 in.	Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.	Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.			

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, δ :	0.0055	0.0109	0.013		
Data dispersion, β_d :	0.35	0.27	0.35		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.36	0.3	0.36		
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Superior	

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

(1) Relocate office eqpt & furniture within 6 ft. of wall, both sides. Install protective covers on floor finishes & adjacent curtain wall system. (2) Remove arch. finishes on wall, both sides. (3) Relocate MEP systems within 6 ft. of wall. (4) Prepare & inject grout 330 ft. of crack per 100 ft2 of wall. (5) Remove 15 ft2 per 100 ft2 of wall & 10 1-ft. long sections of #8 buckled vert. rebar. (6) Replace buckled rebar with new rebar; attach to exposed ends of (E) rebar with mech splices; provide 8 #4 seismic ties at 4 in. oc, ea end of wall; re-bend 16 horiz. rebar in wall around new rebar. (7) Install formwork & cast 5ksi concrete into pockets cut in step 5. (8) Strip forms, clean-up, reinstall/return office eqpt., finishes, furniture & MEP.

(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft lengths. (5) Install bars: a. 12#9 A706 bars in bz ea. end; mech splices to (E); b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/fdr at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt, finishes, furniture & MEP.

Long Lead Time (Yes / No) NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	5.47E+03	6.05E+03	7.97E+03	1.41E+04	1.56E+04	1.93E+04	2.67E+04	2.92E+04	3.55E+04						
Best fit mean:	6.41E+03			1.62E+04			3.02E+04								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Cost (Min Qty, Max Qty)	7.56E+03			1.95E+04			3.64E+04								
CV or beta (Min Qty, Max Qty)	0.16			0.13			0.11								
Quantity Unit:	144 ft^2 Units			144 ft^2 Units			144 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	4.26E+00	4.71E+00	6.21E+00	1.10E+01	1.22E+01	1.50E+01	2.08E+01	2.27E+01	2.76E+01						
Best fit mean:	4.71E+00			1.22E+01			2.27E+01								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Time (Min Qty, Max Qty)	5.89E+00			1.52E+01			2.84E+01								
CV or beta (Min Qty, Max Qty)	0.29			0.28			0.28								
Quantity Unit:	144 ft^2 Units			144 ft^2 Units			144 ft^2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.8E+03	LogNormal	0.29	5.2E+03	LogNormal	0.28	8.1E+03	LogNormal	0.28						
Embodied Energy (MJ)	4.3E+04	LogNormal	0.29	1.1E+05	LogNormal	0.28	1.6E+05	LogNormal	0.28						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%			0%			0%								
Loss of Life (Median, Dispersion)	0%			0%			0%								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%			50%			25%								

Comments: Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Andrew Whittaker

Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.

Root Cost Multiplier: 144

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1044.012

NISTIR Name
Description

Rectangular low aspect ratio concrete walls 8'-16" double curtain; with heights of 16' to 24'
Costing for each 400 ft^2 Wall Panel, Orthogonal web reinforcement, f'c > 2500 psi, P/(A*f'c) <= 0.2

Line 190

Construction Quality:	Not Specified					<div>Quantity RoundingRound Qty?NO</div> <div>Allow sum by floor or building?NO</div> <div>Demand Location (floor above?)No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	SF 400					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	3					
Damage State:	DS1	DS2	DS3			
Type of Damage State:	Sequential	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2,DS3)					
Descriptions	Cracks with maximum widths greater than 0.04 in but less than 0.12 in.	Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.	Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.			

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, δ :	0.0055	0.0109	0.013		
Data dispersion, β_δ :	0.35	0.27	0.35		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.36	0.3	0.36		
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Superior	

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

(1) Relocate office eqpt & furniture within 6 ft. of wall, both sides. Install protective covers on floor finishes & adjacent curtain wall system. (2) Remove arch: finishes on wall, both sides. (3) Relocate MEP systems within 6 ft. of wall. (4) Prepare & inject grout 330 ft. of crack per 100 ft2 of wall. (5) Remove 15 ft2 per 100 ft2 of wall & 10 1-ft. long sections of #8 buckled vert. rebar. (6) Replace buckled rebar with new rebar; attach to exposed ends of (E) rebar with mech splices; provide 8 #4 seismic ties at 4 in. oc, ea end of wall; re-bend 16 horiz. rebar in wall around new rebar. (7) Install formwork & cast 5ksi concrete into pockets cut in step 5. (8) Strip forms, clean-up, reinstall/return office eqpt., finishes, furniture & MEP.

(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft lengths. (5) Install bars: a. 12#9 A706 bars in bz ea. end; mech splices to (E); b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/fdr at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in., with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt, finishes, furniture & MEP.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.68E+04	1.88E+04	2.20E+04	3.87E+04	4.25E+04	5.01E+04	6.90E+04	7.57E+04	9.08E+04						
Best fit mean:	1.91E+04 LogNormal			4.35E+04 LogNormal			7.80E+04 LogNormal								
Best Fit Distribution:	3.00			3.00			3.00								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Cost (Min Qty, Max Qty)	2.35E+04			5.31E+04			9.47E+04								
CV or beta (Min Qty, Max Qty)	0.11			0.10			0.11								
Quantity Unit:	400 ft^2 Units			400 ft^2 Units			400 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.56E+01	1.74E+01	2.04E+01	3.58E+01	3.94E+01	4.64E+01	6.39E+01	7.02E+01	8.42E+01						
Best fit mean:	1.74E+01 LogNormal			3.94E+01 LogNormal			7.02E+01 LogNormal								
Best Fit Distribution:	3.00			3.00			3.00								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Time (Min Qty, Max Qty)	2.18E+01			4.92E+01			8.77E+01								
CV or beta (Min Qty, Max Qty)	0.27			0.27			0.27								
Quantity Unit:	400 ft^2 Units			400 ft^2 Units			400 ft^2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	5.1E+03	LogNormal	0.27	1.4E+04	LogNormal	0.27	2.1E+04	LogNormal	0.27						
Embodied Energy (MJ)	1.2E+05	LogNormal	0.27	2.9E+05	LogNormal	0.27	4.1E+05	LogNormal	0.27						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		50%	0.50		25%	0.50							

Comments: Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Andrew Whittaker
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.

Root Cost Multiplier: 400
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1044.013

NISTIR Name
Description

Rectangular low aspect ratio concrete walls 8"-16" double curtain; with heights of 24' to 40'
Costing for each 900 ft^2 Wall Panel, Orthogonal web reinforcement, f'c > 2500 psi, P/(A*f'c) <= 0.2

Line 191

Construction Quality:	Not Specified					<div>Quantity RoundingRound Qty?NO</div> <div>Allow sum by floor or building?NO</div> <div>Demand Location (floor above?)No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	SF 900					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	3					
Damage State:	DS1	DS2	DS3			
Type of Damage State:	Sequential	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2,DS3)					
Descriptions	Cracks with maximum widths greater than 0.04 in but less than 0.12 in.		Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.		Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.	

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, δ :	0.0055	0.0109	0.013		
Data dispersion, β_δ :	0.35	0.27	0.35		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.36	0.3	0.36		
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Superior	

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

(1) Relocate office eqpt & furniture within 6 ft. of wall, both sides. Install protective covers on floor finishes & adjacent curtain wall system. (2) Remove arch: finishes on wall, both sides. (3) Relocate MEP systems within 6 ft. of wall. (4) Prepare & inject grout 330 ft. of crack per 100 ft2 of wall. (5) Remove 15 ft2 per 100 ft2 of wall & 10 1-ft. long sections of #8 buckled vert. rebar. (6) Replace buckled rebar with new rebar; attach to exposed ends of (E) rebar with mech splices; provide 8 #4 seismic ties at 4 in. oc, ea end of wall; re-bend 16 horiz. rebar in wall around new rebar. (7) Install formwork & cast 5ksi concrete into pockets cut in step 5. (8) Strip forms, clean-up, reinstall/return office eqpt., finishes, furniture & MEP.

(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft lengths. (5) Install bars: a. 12#9 A706 bars in bz ea. end; mech splices to (E); b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/fdr at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in., with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt, finishes, furniture & MEP.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.68E+04	3.96E+04	4.73E+04	8.57E+04	9.11E+04	1.04E+05	1.29E+05	1.47E+05	1.74E+05						
Best fit mean:	4.10E+04 LogNormal			9.32E+04 LogNormal			1.49E+05 LogNormal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00			3.00 7.00								
Average Repair Cost (Min Qty, Max Qty)	4.95E+04 3.37E+04			1.14E+05 7.74E+04			1.84E+05 1.25E+05								
CV or beta (Min Qty, Max Qty)	0.10 0.10			0.08 0.08			0.12 0.12								
Quantity Unit:	900 ft^2 Units			900 ft^2 Units			900 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	3.52E+01	3.79E+01	4.53E+01	8.19E+01	8.70E+01	9.91E+01	1.24E+02	1.41E+02	1.67E+02						
Best fit mean:	3.79E+01 LogNormal			8.70E+01 LogNormal			1.41E+02 LogNormal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00			3.00 7.00								
Average Repair Time (Min Qty, Max Qty)	4.74E+01 3.22E+01			1.09E+02 7.40E+01			1.76E+02 1.20E+02								
CV or beta (Min Qty, Max Qty)	0.27 0.27			0.26 0.26			0.28 0.28								
Quantity Unit:	900 ft^2 Units			900 ft^2 Units			900 ft^2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.1E+04	LogNormal	0.27	3.1E+04	LogNormal	0.26	4.4E+04	LogNormal	0.28						
Embodied Energy (MJ)	2.7E+05	LogNormal	0.27	6.3E+05	LogNormal	0.26	8.0E+05	LogNormal	0.28						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			50% 0.50			25% 0.50								

Comments: Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Andrew Whittaker
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.

Root Cost Multiplier: 900
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1044.021

NISTIR Name
Description

Rectangular low aspect ratio concrete walls 18"-24" thick with double curtain and heights up to 15'
Costing for each 144 ft^2 Wall Panel, Orthogonal web reinforcement, f'c > 2500 psi, P/(A*f'c) <= 0.2

Line 192

Construction Quality:	Not Specified					<div>Quantity RoundingRound Qty?NO</div> <div>Allow sum by floor or building?NO</div> <div>Demand Location (floor above?)No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	SF 144					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	3					
Damage State:	DS1		DS2		DS3	
Type of Damage State:	Sequential		Sequential		Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)					
Descriptions	Cracks with maximum widths greater than 0.04 in but less than 0.12 in.		Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.		Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.	

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, δ :	0.0055	0.0109	0.013		
Data dispersion, β_d :	0.35	0.27	0.35		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.36	0.3	0.36		
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Superior	

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

(1) Relocate office eqpt & furniture within 6 ft. of wall, both sides. Install protective covers on floor finishes & adjacent curtain wall system. (2) Remove arch. finishes on wall, both sides. (3) Relocate MEP systems within 6 ft. of wall. (4) Prepare & inject grout 330 ft. of crack per 100 ft2 of wall. (5) Remove 15 ft2 per 100 ft2 of wall & 10 1-ft. long sections of #8 buckled vert. rebar. (6) Replace buckled rebar with new rebar; attach to exposed ends of (E) rebar with mech splices; provide 8 #4 seismic ties at 4 in. oc, ea end of wall; re-bend 16 horiz. rebar in wall around new rebar. (7) Install formwork & cast 5ksi concrete into pockets cut in step 5. (8) Strip forms, clean-up, reinstall/return office eqpt., finishes, furniture & MEP.

(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft lengths. (5) Install bars: a. 12#9 A706 bars in bz ea. end; mech splices to (E); b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/fdr at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in., with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt, finishes, furniture & MEP.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	7.63E+03	8.21E+03	1.01E+04	1.73E+04	1.88E+04	2.34E+04	3.30E+04	3.69E+04	4.17E+04						
Best fit mean:	8.59E+03			1.97E+04			3.70E+04								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00			7.00					
Average Repair Cost (Min Qty, Max Qty)	1.03E+04			2.36E+04			4.61E+04			3.13E+04					
CV or beta (Min Qty, Max Qty)	0.12			0.12			0.09			0.09					
Quantity Unit:	144 ft^2 Units			144 ft^2 Units			144 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.95E+00	6.39E+00	7.89E+00	1.35E+01	1.47E+01	1.82E+01	2.57E+01	2.87E+01	3.25E+01						
Best fit mean:	6.39E+00			1.47E+01			2.87E+01								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00			7.00					
Average Repair Time (Min Qty, Max Qty)	7.99E+00			1.84E+01			3.59E+01			2.44E+01					
CV or beta (Min Qty, Max Qty)	0.28			0.28			0.27			0.27					
Quantity Unit:	144 ft^2 Units			144 ft^2 Units			144 ft^2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.7E+03	LogNormal	0.28	6.5E+03	LogNormal	0.28	1.2E+04	LogNormal	0.27						
Embodied Energy (MJ)	6.4E+04	LogNormal	0.28	1.3E+05	LogNormal	0.28	2.1E+05	LogNormal	0.27						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%			0%			0%			0%					
Loss of Life (Median, Dispersion)	0%			0%			0%			0%					
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%			50%			25%			0.50					

Comments: Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Andrew Whittaker

Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.

Root Cost Multiplier: 144

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1044.022

NISTIR Name
Description

Rectangular low aspect ratio concrete walls 18"-24" thick with double curtain and heights 16' - 24'
Costing for each 400 ft^2 Wall Panel, Orthogonal web reinforcement, $f_c > 2500$ psi, $P/(A*f_c) < 0.2$

Line 193

Construction Quality:	Not Specified					<div>Quantity RoundingRound Qty? NO Allow sum by floor or building? NO Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	SF 400					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	3					
Damage State:	DS1	DS2	DS3			
Type of Damage State:	Sequential	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2,DS3)					
Descriptions	Cracks with maximum widths greater than 0.04 in but less than 0.12 in.	Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.	Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.			

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, δ :	0.0055	0.0109	0.013		
Data dispersion, β_d :	0.35	0.27	0.35		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.36	0.3	0.36		
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Superior	

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

(1) Relocate office eqpt & furniture within 6 ft. of wall, both sides. Install protective covers on floor finishes & adjacent curtain wall system. (2) Remove arch. finishes on wall, both sides. (3) Relocate MEP systems within 6 ft. of wall. (4) Prepare & inject grout 330 ft. of crack per 100 ft2 of wall. (5) Remove 15 ft2 per 100 ft2 of wall & 10 1-ft. long sections of #8 buckled vert. rebar. (6) Replace buckled rebar with new rebar; attach to exposed ends of (E) rebar with mech splices; provide #4 seismic ties at 4 in. oc, ea end of wall; re-bend 16 horiz. rebar in wall around new rebar. (7) Install formwork & cast 5ksi concrete into pockets cut in step 5. (8) Strip forms, clean-up, reinstall/return office eqpt., finishes, furniture & MEP.

(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft lengths. (5) Install bars: a. 12#9 A706 bars in bz ea. end; mech splices to (E); b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/fdr at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in., with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt, finishes, furniture & MEP.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.28E+04	2.48E+04	2.80E+04	4.77E+04	5.15E+04	5.91E+04	8.66E+04	9.73E+04	1.09E+05						
Best fit mean:	2.51E+04 LogNormal			5.26E+04 LogNormal			9.73E+04 LogNormal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00			7.00					
Average Repair Cost (Min Qty, Max Qty)	3.10E+04			6.44E+04			1.22E+05			8.27E+04					
CV or beta (Min Qty, Max Qty)	0.08			0.09			0.09			0.09					
Quantity Unit:	400 ft^2 Units			400 ft^2 Units			400 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.11E+01	2.30E+01	2.60E+01	4.42E+01	4.77E+01	5.48E+01	8.02E+01	9.02E+01	1.01E+02						
Best fit mean:	2.30E+01 LogNormal			4.77E+01 LogNormal			9.02E+01 LogNormal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00			7.00					
Average Repair Time (Min Qty, Max Qty)	2.87E+01			5.96E+01			1.13E+02			7.66E+01					
CV or beta (Min Qty, Max Qty)	0.26			0.26			0.27			0.27					
Quantity Unit:	400 ft^2 Units			400 ft^2 Units			400 ft^2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	7.5E+03	LogNormal	0.26	1.8E+04	LogNormal	0.26	3.1E+04	LogNormal	0.27						
Embodied Energy (MJ)	1.8E+05	LogNormal	0.26	3.6E+05	LogNormal	0.26	5.5E+05	LogNormal	0.27						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%			0%			0%			0%					
Loss of Life (Median, Dispersion)	0%			0%			0%			0%					
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%			50%			25%			0.50					

Comments: Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Andrew Whittaker
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.

Root Cost Multiplier: 400
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1044.023

NISTIR Name

Rectangular low aspect ratio concrete walls 18"-24" thick with double curtain and heights 25' - 40'

Description

Costing for each 900 ft^2 Wall Panel, Orthogonal web reinforcement, $f_c > 2500$ psi, $P/(A \cdot f_c) \leq 0.2$

Line 194

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

SF 900

Demand Parameter (unit):

Story Drift Ratio

Unit less

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

Cracks with maximum widths greater than 0.04 in but less than 0.12 in.

Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.

Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Illustrations



Damage State Probability:

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.0055

0.0109

0.013

Data dispersion, β_d :

0.35

0.27

0.35

Uncertainty, β_u :

0.1

0.1

0.1

Total Dispersion, β :

0.36

0.3

0.36

Correlation (Yes / No)

NO

Data Quality Average

Documentation Quality Superior

Directionality (Yes / No)

YES

Data Relevance Average

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

(1) Relocate office eqpt & furniture within 6 ft. of wall, both sides. Install protective covers on floor finishes & adjacent curtain wall system. (2) Remove arch: finishes on wall, both sides. (3) Relocate MEP systems within 6 ft. of wall. (4) Prepare & inject grout 330 ft. of crack per 100 ft2 of wall. (5) Remove 15 ft2 per 100 ft2 of wall & 10 1-ft. long sections of #8 buckled vert. rebar. (6) Replace buckled rebar with new rebar; attach to exposed ends of (E) rebar with mech splices; provide #4 seismic ties at 4 in. oc, ea end of wall; re-bend 16 horiz. rebar in wall around new rebar. (7) Install formwork & cast 5ksi concrete into pockets cut in step 5. (8) Strip forms, clean-up, reinstall/return office eqpt., finishes, furniture & MEP.

(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft lengths. (5) Install bars: a. 12#9 A706 bars in bz ea. end; mech splices to (E); b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/fdr at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in., with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt, finishes, furniture & MEP.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	5.03E+04	5.31E+04	6.08E+04	1.06E+05	1.11E+05	1.24E+05	1.62E+05	1.89E+05	2.28E+05						
Best fit mean:	5.46E+04			1.13E+05			1.91E+05								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00			7.00					
Average Repair Cost (Min Qty, Max Qty)	6.64E+04			1.39E+05			2.36E+05			1.61E+05					
CV or beta (Min Qty, Max Qty)	0.08			0.06			0.13			0.13					
Quantity Unit:	900 ft^2 Units			900 ft^2 Units			900 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	4.81E+01	5.08E+01	5.81E+01	1.01E+02	1.06E+02	1.18E+02	1.55E+02	1.81E+02	2.18E+02						
Best fit mean:	5.08E+01			1.06E+02			1.81E+02								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00			7.00					
Average Repair Time (Min Qty, Max Qty)	6.34E+01			1.33E+02			2.26E+02			1.53E+02					
CV or beta (Min Qty, Max Qty)	0.26			0.26			0.28			0.28					
Quantity Unit:	900 ft^2 Units			900 ft^2 Units			900 ft^2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.7E+04	LogNormal	0.26	3.9E+04	LogNormal	0.26	6.4E+04	LogNormal	0.28						
Embodied Energy (MJ)	4.0E+05	LogNormal	0.26	7.8E+05	LogNormal	0.26	1.1E+06	LogNormal	0.28						
LifeSafety Hazard:	Potential non-collapse casualties? (Yes / No)	NO		Potential non-collapse casualties? (Yes / No)	NO		Potential non-collapse casualties? (Yes / No)	NO							
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		50%	0.50		25%	0.50							

Comments:

Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Andrew Whittaker

Revisions:

2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.

Root Cost Multiplier:

900

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1044.031

NISTIR Name

Low-rise reinforced concrete walls with return flanges, less than 8" thick up to 15' high
Costing for each 144 ft^2 Wall Panel, Orthogonal web reinforcement, f'c > 2500 psi, P/(A*f'c) <= 0.2

Description

Line 195

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

SF 144

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	NO	

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.

Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.

Illustrations



Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.0076

0.0134

Data dispersion, β_d :

0.33

0.45

Uncertainty, β_u :

0.1

0.1

Total Dispersion, β :

0.35

0.45

Correlation (Yes / No)

NO

Data Quality Average

Documentation Quality Superior

Directionality (Yes / No)

YES

Data Relevance Average

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12# A706 bars in bz ea. end; mech splices to (E); b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/dm at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt, finishes, furniture & MEP.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.19E+04	1.35E+04	1.67E+04	1.99E+04	2.29E+04	3.07E+04									
Best fit mean:	1.39E+04			2.41E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00											
Average Repair Cost (Min Qty, Max Qty)	1.68E+04			2.86E+04											
CV or beta (Min Qty, Max Qty)	0.14			0.18											
Quantity Unit:	144 ft^2 Units			144 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.29E+00	1.05E+01	1.30E+01	1.55E+01	1.79E+01	2.39E+01									
Best fit mean:	1.05E+01			1.79E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00											
Average Repair Time (Min Qty, Max Qty)	1.31E+01			2.23E+01											
CV or beta (Min Qty, Max Qty)	0.28			0.31											
Quantity Unit:	144 ft^2 Units			144 ft^2 Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.5E+03	LogNormal	0.28	5.7E+03	LogNormal	0.31									
Embodied Energy (MJ)	9.3E+04	LogNormal	0.28	1.1E+05	LogNormal	0.31									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%			0%											
Loss of Life (Median, Dispersion)	0%			0%											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	50%			25%											

Comments:

Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Andrew Whittaker

Revisions:

2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.

Root Cost Multiplier: 144

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1044.032

NISTIR Name
Description

Low-rise reinforced concrete walls with return flanges, less than 8" thick, 16' to 24' high
Costing for each 400 ft^2 Wall Panel, Orthogonal web reinforcement, f'c > 2500 psi, P/(A*f'c) <= 0.2

Line 196

Construction Quality:	Not Specified					Quantity Rounding Round Qty? NO Allow sum by floor or building? NO Demand Location (floor above?) No
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	SF 400					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.		Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.			

Illustrations



Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.0076	0.0134			
Data dispersion, β_d :	0.33	0.45			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.35	0.45			
Correlation (Yes / No)	NO		Data Quality Average	Documentation Quality Superior	
Directionality (Yes / No)	YES		Data Relevance Average	Rationality Superior	

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12# A706 bars in bz ea. end; mech splices to (E) ; b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/dm at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt, finishes, furniture & MEP.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.27E+04	3.65E+04	4.41E+04	5.56E+04	6.03E+04	8.31E+04									
Best fit mean:	3.75E+04			6.53E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00											
Average Repair Cost (Min Qty, Max Qty)	4.57E+04			7.54E+04											
CV or beta (Min Qty, Max Qty)	0.12			0.17											
Quantity Unit:	400 ft^2 Units			400 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	3.03E+01	3.38E+01	4.09E+01	5.15E+01	5.59E+01	7.70E+01									
Best fit mean:	3.38E+01			5.59E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00											
Average Repair Time (Min Qty, Max Qty)	4.23E+01			6.99E+01											
CV or beta (Min Qty, Max Qty)	0.28			0.30											
Quantity Unit:	400 ft^2 Units			400 ft^2 Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.2E+04	LogNormal	0.28	1.6E+04	LogNormal	0.30									
Embodied Energy (MJ)	2.5E+05	LogNormal	0.28	3.0E+05	LogNormal	0.30									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	50% 0.50			25% 0.50											

Comments: Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Andrew Whittaker
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.

Root Cost Multiplier: 400
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1044.033

NISTIR Name
Description

Low-rise reinforced concrete walls with return flanges, less than 8" thick, 25' to 40' high
Costing for each 900 ft^2 Wall Panel, Orthogonal web reinforcement, f'c > 2500 psi, P/(A*f'c) <= 0.2

Line 197

Construction Quality:		Not Specified			<div>Quantity RoundingRound Qty? NO Allow sum by floor or building? NO Demand Location (floor above?) No</div>
Seismic Installation Conditions:		Not Specified			
Fragility Unit of Measure:		SF 900			
Demand Parameter (unit):		Story Drift RatioUnit less			
Number of Damage States:		2			
Damage State:		DS1	DS2		
Type of Damage State:		Sequential	Sequential		
DS Hierarchy		Seq(DS1,DS2)			
Descriptions		Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.	Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.		

Illustrations



Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.0076	0.0134			
Data dispersion, β_d :	0.33	0.45			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.35	0.45			
Correlation (Yes / No)	NO		Data Quality Average	Documentation Quality Superior	
Directionality (Yes / No)	YES		Data Relevance Average	Rationality Superior	

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12# A706 bars in bz ea. end; mech splices to (E) ; b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/dm at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt, finishes, furniture & MEP.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	7.22E+04	7.76E+04	9.02E+04	1.00E+05	1.19E+05	1.50E+05									
Best fit mean:	7.97E+04			1.21E+05											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00											
Average Repair Cost (Min Qty, Max Qty)	9.70E+04			1.48E+05											
CV or beta (Min Qty, Max Qty)	0.09			0.16											
Quantity Unit:	900 ft^2 Units			900 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	6.90E+01	7.42E+01	8.62E+01	9.58E+01	1.13E+02	1.43E+02									
Best fit mean:	7.42E+01			1.13E+02											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00											
Average Repair Time (Min Qty, Max Qty)	9.27E+01			1.42E+02											
CV or beta (Min Qty, Max Qty)	0.27			0.30											
Quantity Unit:	900 ft^2 Units			900 ft^2 Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.7E+04	LogNormal	0.27	3.3E+04	LogNormal	0.30									
Embodied Energy (MJ)	5.4E+05	LogNormal	0.27	6.0E+05	LogNormal	0.30									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%			0%											
Loss of Life (Median, Dispersion)	0%			0%											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	50%			25%											

Comments: Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Andrew Whittaker
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.

Root Cost Multiplier: 900
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification B1044.041

NISTIR Name Low-rise reinforced concrete walls with return flanges, 8" to 16" thick up to 15' high

Description Costing for each 144 ft^2 Wall Panel, Orthogonal web reinforcement, f'c > 2500 psi, P/(A*f'c) <= 0.2

Line 198

Construction Quality:	Not Specified					Quantity Rounding Round Qty? NO Allow sum by floor or building? NO Demand Location (floor above?) No
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	SF 144					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.		Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.			

Illustrations



Damage State Probability:	1.00		1.00		
Fragility Parameters					
Median Demand, θ :	0.0076		0.0134		
Data dispersion, β_d :	0.33		0.45		
Uncertainty, β_u :	0.1		0.1		
Total Dispersion, β :	0.35		0.45		
Correlation (Yes / No)	NO		Data Quality Average		
Directionality (Yes / No)	YES		Documentation Quality Superior		
			Data Relevance Average		
			Rationality Superior		

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12# A706 bars in bz ea. end; mech splices to (E) ; b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/dm at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt, finishes, furniture & MEP.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.38E+04	1.53E+04	1.86E+04	2.54E+04	2.92E+04	3.60E+04									
Best fit mean:	1.58E+04			2.99E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00			7.00											
Average Repair Cost (Min Qty, Max Qty)	1.92E+04			3.64E+04			2.48E+04								
CV or beta (Min Qty, Max Qty)	0.12			0.12			0.14								
Quantity Unit:	144 ft^2 Units			144 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.07E+01	1.19E+01	1.45E+01	1.98E+01	2.27E+01	2.81E+01									
Best fit mean:	1.19E+01			2.27E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00			7.00											
Average Repair Time (Min Qty, Max Qty)	1.49E+01			2.84E+01			1.93E+01								
CV or beta (Min Qty, Max Qty)	0.28			0.29			0.29								
Quantity Unit:	144 ft^2 Units			144 ft^2 Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	5.1E+03	LogNormal	0.28	8.1E+03	LogNormal	0.29									
Embodied Energy (MJ)	1.0E+05	LogNormal	0.28	1.6E+05	LogNormal	0.29									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%			0%			0%								
Loss of Life (Median, Dispersion)	0%			0%			0%								
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	50%			25%			0.50								

Comments: Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Andrew Whittaker

Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.

Root Cost Multiplier: 144

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1044.042

NISTIR Name
Description

Low-rise reinforced concrete walls with return flanges, 8" to 16" thick, 16' to 24' high
Costing for each 400 ft*2 Wall Panel, Orthogonal web reinforcement, $f_c > 2500$ psi, $P/(A*f_c) \leq 0.2$

Line 199

Construction Quality:	Not Specified					Quantity Rounding Round Qty? NO Allow sum by floor or building? NO Demand Location (floor above?) No
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	SF 400					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.		Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.			

Illustrations



Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.0076	0.0134			
Data dispersion, β_d :	0.33	0.45			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.35	0.45			
Correlation (Yes / No)	NO		Data Quality Average	Documentation Quality Superior	
Directionality (Yes / No)	YES		Data Relevance Average	Rationality Superior	

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12# A706 bars in bz ea. end; mech splices to (E) ; b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/dm at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt, finishes, furniture & MEP.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Cost by Damage State:	3.79E+04	4.17E+04	4.93E+04	6.90E+04	7.76E+04	1.00E+05									
Best fit mean:	4.27E+04			8.12E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00			7.00											
Average Repair Cost (Min Qty, Max Qty)	5.21E+04			9.71E+04			6.60E+04								
CV or beta (Min Qty, Max Qty)	0.11			0.15			0.15								
Quantity Unit:	400 ft*2 Units			400 ft*2 Units											
Repair Time:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Time by Damage State:	3.51E+01	3.86E+01	4.57E+01	6.39E+01	7.19E+01	9.29E+01									
Best fit mean:	3.86E+01			7.19E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00			7.00											
Average Repair Time (Min Qty, Max Qty)	4.83E+01			8.99E+01			6.11E+01								
CV or beta (Min Qty, Max Qty)	0.27			0.29			0.29								
Quantity Unit:	400 ft*2 Units			400 ft*2 Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.4E+04	LogNormal	0.27	2.2E+04	LogNormal	0.29									
Embodied Energy (MJ)	2.8E+05	LogNormal	0.27	4.3E+05	LogNormal	0.29									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%			0%			0%								
Loss of Life (Median, Dispersion)	0%			0%			0%								
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	50%			25%			0.50								

Comments: Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Andrew Whittaker
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.

Root Cost Multiplier: 400
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1044.043

NISTIR Name
Description

Low-rise reinforced concrete walls with return flanges, 8" to 16" thick, 25' to 40' high
Costing for each 900 ft^2 Wall Panel, Orthogonal web reinforcement, f'c > 2500 psi, P/(A*f'c) <= 0.2

Line 200

Construction Quality:	Not Specified					<div>Quantity RoundingRound Qty?NO</div> <div>Allow sum by floor or building?NO</div> <div>Demand Location (floor above?)No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	SF 900					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.		Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.			

Illustrations

				
B1044.031-DS1-1.JPG	B1044.031-DS2-1.JPG			
1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.0076	0.0134			
Data dispersion, β_d :	0.33	0.45			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.35	0.45			
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Superior	

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12# A706 bars in bz ea. end; mech splices to (E) ; b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/dm at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt, finishes, furniture & MEP.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	8.39E+04	8.93E+04	1.02E+05	1.24E+05	1.52E+05	1.82E+05									
Best fit mean:	9.13E+04			1.53E+05											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00			7.00											
Average Repair Cost (Min Qty, Max Qty)	1.12E+05			7.59E+04			1.90E+05			1.29E+05					
CV or beta (Min Qty, Max Qty)	0.08			0.08			0.15			0.15					
Quantity Unit:	900 ft^2 Units			900 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.02E+01	8.53E+01	9.74E+01	1.19E+02	1.45E+02	1.74E+02									
Best fit mean:	8.53E+01			1.45E+02											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00			7.00											
Average Repair Time (Min Qty, Max Qty)	1.07E+02			7.25E+01			1.81E+02			1.23E+02					
CV or beta (Min Qty, Max Qty)	0.26			0.26			0.29			0.29					
Quantity Unit:	900 ft^2 Units			900 ft^2 Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	3.1E+04	LogNormal	0.26	4.5E+04	Normal	0.29									
Embodied Energy (MJ)	6.1E+05	LogNormal	0.26	8.5E+05	Normal	0.29									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%			0%											
Loss of Life (Median, Dispersion)	0%			0%											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	50%			25%											

Comments: Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Andrew Whittaker

Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.

Root Cost Multiplier: 900

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1044.051

NISTIR Name
Description

Low-rise reinforced concrete walls with return flanges, 17" to 24" thick" up to 15' high
Costing for each 144 ft^2 Wall Panel, Orthogonal web reinforcement, f'c > 2500 psi, P/(A*f'c) <= 0.2

Line 201

Construction Quality:	Not Specified					<div>Quantity RoundingRound Qty?NO</div> <div>Allow sum by floor or building?NO</div> <div>Demand Location (floor above?)No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	SF 144					
Demand Parameter (unit):	Story Drift RatioUnit less					
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.		Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.			

Illustrations

				
B1044.031-DS1-1.JPG	B1044.031-DS2-1.JPG			
1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.0076	0.0134			
Data dispersion, β_d :	0.33	0.45			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.35	0.45			
Correlation (Yes / No)	NO		Data Quality Average	Documentation Quality Superior	
Directionality (Yes / No)	YES		Data Relevance Average	Rationality Superior	

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12# A706 bars in bz ea. end; mech splices to (E) ; b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/dm at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt, finishes, furniture & MEP.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.69E+04	1.84E+04	2.17E+04	3.17E+04	3.69E+04	4.33E+04									
Best fit mean:	1.89E+04			3.70E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00			7.00											
Average Repair Cost (Min Qty, Max Qty)	1.92E+04			3.77E+04			2.56E+04								
CV or beta (Min Qty, Max Qty)	0.10			0.12			0.12								
Quantity Unit:	144 ft^2 Units			144 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.07E+01	1.19E+01	1.45E+01	2.01E+01	2.35E+01	2.94E+01									
Best fit mean:	1.19E+01			2.35E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00			7.00											
Average Repair Time (Min Qty, Max Qty)	1.49E+01			2.94E+01			2.00E+01								
CV or beta (Min Qty, Max Qty)	0.27			0.28			0.28								
Quantity Unit:	144 ft^2 Units			144 ft^2 Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.3E+03	LogNormal	0.27	1.2E+04	LogNormal	0.28									
Embodied Energy (MJ)	1.3E+05	LogNormal	0.27	2.1E+05	LogNormal	0.28									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%			0%											
Loss of Life (Median, Dispersion)	0%			0%											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	50%			25%											

Comments: Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Andrew Whittaker

Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.

Root Cost Multiplier: 144

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1044.052

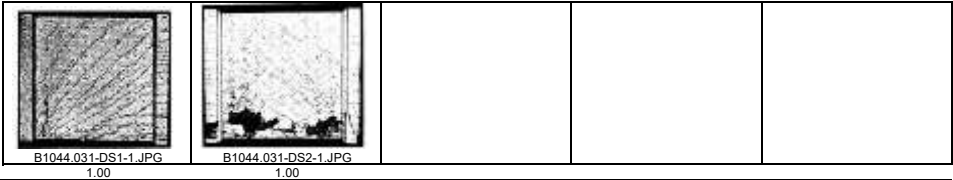
NISTIR Name
Description

Low-rise reinforced concrete walls with return flanges, 17" to 24" thick, 16' to 24' high
Costing for each 400 ft^2 Wall Panel, Orthogonal web reinforcement, f'c > 2500 psi, P/(A*f'c) <= 0.2

Line 202

Construction Quality:	Not Specified					Quantity Rounding Round Qty? NO Allow sum by floor or building? NO Demand Location (floor above?) No
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	SF 400					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.		Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.			

Illustrations



Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.0076	0.0134			
Data dispersion, β_d :	0.33	0.45			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.35	0.45			
Correlation (Yes / No)	NO		Data Quality Average	Documentation Quality Superior	
Directionality (Yes / No)	YES		Data Relevance Average	Rationality Superior	

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12# A706 bars in bz ea. end; mech splices to (E) ; b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/dm at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt, finishes, furniture & MEP.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	4.65E+04	5.03E+04	5.79E+04	8.66E+04	9.92E+04	1.18E+05									
Best fit mean:	5.13E+04			1.00E+05											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00			7.00											
Average Repair Cost (Min Qty, Max Qty)	6.29E+04			4.28E+04			1.24E+05			8.43E+04					
CV or beta (Min Qty, Max Qty)	0.09			0.09			0.12			0.12					
Quantity Unit:	400 ft^2 Units			400 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	4.31E+01	4.66E+01	5.36E+01	8.02E+01	9.19E+01	1.09E+02									
Best fit mean:	4.66E+01			9.19E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00			7.00											
Average Repair Time (Min Qty, Max Qty)	5.83E+01			3.96E+01			1.15E+02			7.81E+01					
CV or beta (Min Qty, Max Qty)	0.26			0.26			0.28			0.28					
Quantity Unit:	400 ft^2 Units			400 ft^2 Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.7E+04	LogNormal	0.26	3.2E+04	LogNormal	0.28									
Embodied Energy (MJ)	3.5E+05	LogNormal	0.26	5.7E+05	LogNormal	0.28									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	50% 0.50			25% 0.50											

Comments: Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Andrew Whittaker

Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.

Root Cost Multiplier: 400

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1044.053

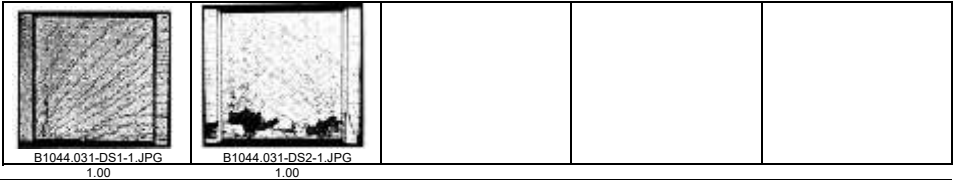
NISTIR Name
Description

Low-rise reinforced concrete walls with return flanges, 17" to 24" thick, 25' to 40' high
Costing for each 900 ft^2 Wall Panel, Orthogonal web reinforcement, f'c > 2500 psi, P/(A*f'c) <= 0.2

Line 203

Construction Quality:	Not Specified					<div>Quantity RoundingRound Qty?NO</div> <div>Allow sum by floor or building?NO</div> <div>Demand Location (floor above?)No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	SF 900					
Demand Parameter (unit):	Story Drift RatioUnit less					
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.		Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.			

Illustrations



Damage State Probability:	1.00		1.00		
Fragility Parameters					
Median Demand, θ :	0.0076		0.0134		
Data dispersion, β_d :	0.33		0.45		
Uncertainty, β_u :	0.1		0.1		
Total Dispersion, β :	0.35		0.45		
Correlation (Yes / No)	NO		Data Quality Average		Documentation Quality Superior
Directionality (Yes / No)	YES		Data Relevance Average		Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12# A706 bars in bz ea. end; mech splices to (E) ; b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/dm at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt, finishes, furniture & MEP.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.03E+05	1.09E+05	1.21E+05	1.57E+05	1.93E+05	2.26E+05									
Best fit mean:	1.11E+05			1.92E+05											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00			7.00											
Average Repair Cost (Min Qty, Max Qty)	1.36E+05			9.23E+04			2.42E+05			1.64E+05					
CV or beta (Min Qty, Max Qty)	0.06			0.06			0.14			0.14					
Quantity Unit:	900 ft^2 Units			900 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.86E+01	1.04E+02	1.16E+02	1.50E+02	1.85E+02	2.16E+02									
Best fit mean:	1.04E+02			1.85E+02											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00			7.00											
Average Repair Time (Min Qty, Max Qty)	1.30E+02			8.82E+01			2.31E+02			1.57E+02					
CV or beta (Min Qty, Max Qty)	0.26			0.26			0.29			0.29					
Quantity Unit:	900 ft^2 Units			900 ft^2 Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	3.8E+04	LogNormal	0.26	6.6E+04	Normal	0.29									
Embodied Energy (MJ)	7.6E+05	LogNormal	0.26	1.1E+06	Normal	0.29									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%			0%											
Loss of Life (Median, Dispersion)	0%			0%											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	50%			25%											

Comments: Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Andrew Whittaker

Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.

Root Cost Multiplier: 900

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification B1044.061

NISTIR Name Low rise reinforced concrete walls with boundary columns, less than 8" thick, height <15'

Description Costing for each 144 ft^2 Wall Panel, Orthogonal web reinforcement, f'c > 2500 psi, P/(A*f'c) <= 0.2

Line 204

Construction Quality:	Not Specified					Quantity Rounding Round Qty? NO Allow sum by floor or building? NO Demand Location (floor above?) No
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	SF 144					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.		Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.			

Illustrations



Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.0033	0.0087			
Data dispersion, β_d :	0.33	0.18			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.35	0.2			
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Superior	

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12# A706 bars in bz ea. end; mech splices to (E) ; b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/dm at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt, finishes, furniture & MEP.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.19E+04	1.35E+04	1.67E+04	1.99E+04	2.29E+04	3.07E+04									
Best fit mean:	1.39E+04			2.41E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00									
Average Repair Cost (Min Qty, Max Qty)	1.68E+04		1.14E+04	2.86E+04		1.95E+04									
CV or beta (Min Qty, Max Qty)	0.14		0.14	0.18		0.18									
Quantity Unit:	144 ft^2 Units			144 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.29E+00	1.05E+01	1.30E+01	1.55E+01	1.79E+01	2.39E+01									
Best fit mean:	1.05E+01			1.79E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00									
Average Repair Time (Min Qty, Max Qty)	1.31E+01		8.92E+00	2.23E+01		1.52E+01									
CV or beta (Min Qty, Max Qty)	0.28		0.28	0.31		0.31									
Quantity Unit:	144 ft^2 Units			144 ft^2 Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.5E+03	LogNormal	0.28	5.7E+03	LogNormal	0.31									
Embodied Energy (MJ)	9.3E+04	LogNormal	0.28	1.1E+05	LogNormal	0.31									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%		0.00	0%		0.00									
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00									
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	50%		0.50	25%		0.50									

Comments: Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Andrew Whittaker

Revisions: None

Root Cost Multiplier: 144

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1044.062

NISTIR Name

Low rise reinforced concrete walls with boundary columns, less than 8" thick, height between 16'-24'

Description

Costing for each 400 ft^2 Wall Panel, Orthogonal web reinforcement, f'c > 2500 psi, P/(A*f'c) <= 0.2

Line 205

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

SF 400

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.

Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.

Illustrations



Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.0033

0.0087

Data dispersion, β_d :

0.33

0.18

Uncertainty, β_u :

0.1

0.1

Total Dispersion, β :

0.35

0.2

Correlation (Yes / No)

NO

Data Quality Average

Documentation Quality Superior

Directionality (Yes / No)

YES

Data Relevance Average

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary). (1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12# A706 bars in bz ea. end; mech splices to (E) ; b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/dm at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt, finishes, furniture & MEP.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.27E+04	3.65E+04	4.41E+04	5.56E+04	6.03E+04	8.31E+04									
Best fit mean:	3.75E+04			6.53E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00											
Average Repair Cost (Min Qty, Max Qty)	4.57E+04			7.54E+04											
CV or beta (Min Qty, Max Qty)	0.12			0.17											
Quantity Unit:	400 ft^2 Units			400 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	3.03E+01	3.38E+01	4.09E+01	5.15E+01	5.59E+01	7.70E+01									
Best fit mean:	3.38E+01			5.59E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00											
Average Repair Time (Min Qty, Max Qty)	4.23E+01			6.99E+01											
CV or beta (Min Qty, Max Qty)	0.28			0.30											
Quantity Unit:	400 ft^2 Units			400 ft^2 Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.2E+04	LogNormal	0.28	1.6E+04	LogNormal	0.30									
Embodied Energy (MJ)	2.5E+05	LogNormal	0.28	3.0E+05	LogNormal	0.30									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%			0%											
Loss of Life (Median, Dispersion)	0%			0%											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	50%			25%											

Comments:

Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Andrew Whittaker

Revisions:

None

Root Cost Multiplier: 400

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1044.063

NISTIR Name

Low rise reinforced concrete walls with boundary columns, less than 8" thick, height between 24'-40'

Description

Costing for each 900 ft^2 Wall Panel, Orthogonal web reinforcement, f'c > 2500 psi, P/(A*f'c) <= 0.2

Line 206

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

SF 900

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.

Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.

Illustrations



Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.0033

0.0087

Data dispersion, β_d :

0.33

0.18

Uncertainty, β_u :

0.1

0.1

Total Dispersion, β :

0.35

0.2

Correlation (Yes / No)

NO

Data Quality Average

Documentation Quality Superior

Directionality (Yes / No)

YES

Data Relevance Average

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary). (1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12# A706 bars in bz ea. end; mech splices to (E) ; b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/dm at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt, finishes, furniture & MEP.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	7.22E+04	7.76E+04	9.02E+04	1.00E+05	1.19E+05	1.50E+05									
Best fit mean:	7.97E+04			1.21E+05											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00											
Average Repair Cost (Min Qty, Max Qty)	9.70E+04			1.48E+05											
CV or beta (Min Qty, Max Qty)	0.09			0.16											
Quantity Unit:	900 ft^2 Units			900 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	6.90E+01	7.42E+01	8.62E+01	9.58E+01	1.13E+02	1.43E+02									
Best fit mean:	7.42E+01			1.13E+02											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00											
Average Repair Time (Min Qty, Max Qty)	9.27E+01			1.42E+02											
CV or beta (Min Qty, Max Qty)	0.27			0.30											
Quantity Unit:	900 ft^2 Units			900 ft^2 Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.7E+04	LogNormal	0.27	3.3E+04	LogNormal	0.30									
Embodied Energy (MJ)	5.4E+05	LogNormal	0.27	6.0E+05	LogNormal	0.30									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%			0%											
Loss of Life (Median, Dispersion)	0%			0%											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	50%			25%											

Comments:

Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Andrew Whittaker

Revisions:

None

Root Cost Multiplier: 900

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1044.071

NISTIR Name

Low rise reinforced concrete walls with boundary columns, 8" to 16" thick, height <15'
Costing for each 144 ft^2 Wall Panel, Orthogonal web reinforcement, f'c > 2500 psi, P/(A*f'c) <= 0.2

Description

Line 207

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

SF 144

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	NO	

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.

Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.

Illustrations



Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.0033

0.0087

Data dispersion, β_d :

0.33

0.18

Uncertainty, β_u :

0.1

0.1

Total Dispersion, β :

0.35

0.2

Correlation (Yes / No)

NO

Data Quality Average

Documentation Quality Superior

Directionality (Yes / No)

YES

Data Relevance Average

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).
(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft lengths. (5) Install bars: a. 12# A706 bars in bz ea. end; mech splices to (E); b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/dm at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt, finishes, furniture & MEP.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.38E+04	1.53E+04	1.86E+04	2.57E+04	3.01E+04	3.77E+04									
Best fit mean:	1.58E+04			3.08E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00			7.00											
Average Repair Cost (Min Qty, Max Qty)	1.92E+04			3.77E+04											
CV or beta (Min Qty, Max Qty)	0.12			0.15											
Quantity Unit:	144 ft^2 Units			144 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.07E+01	1.19E+01	1.45E+01	2.01E+01	2.35E+01	2.94E+01									
Best fit mean:	1.19E+01			2.35E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00			7.00											
Average Repair Time (Min Qty, Max Qty)	1.49E+01			2.94E+01											
CV or beta (Min Qty, Max Qty)	0.28			0.29											
Quantity Unit:	144 ft^2 Units			144 ft^2 Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	5.1E+03	LogNormal	0.28	8.7E+03	LogNormal	0.29									
Embodied Energy (MJ)	1.0E+05	LogNormal	0.28	1.9E+05	LogNormal	0.29									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%			0%											
Loss of Life (Median, Dispersion)	0%			0%											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	50%			25%											

Comments:

Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Andrew Whittaker

Revisions:

None

Root Cost Multiplier: 144

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1044.072

NISTIR Name
Description

Low rise reinforced concrete walls with boundary columns, 8" to 16" thick, height between 16'-24'
Costing for each 400 ft^2 Wall Panel, Orthogonal web reinforcement, f'c > 2500 psi, P/(A*f'c) <= 0.2

Line 208

Construction Quality:	Not Specified					Quantity Rounding Round Qty? NO Allow sum by floor or building? NO Demand Location (floor above?) No
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	SF 400					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.		Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.			

Illustrations

				
B1044.061-DS1-1.JPG	B1044.061-DS2-1.JPG			

Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.0033	0.0087			
Data dispersion, β_d :	0.33	0.18			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.35	0.2			
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Superior	

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12# A706 bars in bz ea. end; mech splices to (E) ; b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/dm at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt, finishes, furniture & MEP.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.79E+04	4.17E+04	4.93E+04	6.90E+04	7.76E+04	1.00E+05									
Best fit mean:	4.27E+04			8.12E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00											
Average Repair Cost (Min Qty, Max Qty)	5.21E+04			9.71E+04											
CV or beta (Min Qty, Max Qty)	0.11			0.15											
Quantity Unit:	400 ft^2 Units			400 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	3.51E+01	3.86E+01	4.57E+01	6.39E+01	7.19E+01	9.29E+01									
Best fit mean:	3.86E+01			7.19E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00											
Average Repair Time (Min Qty, Max Qty)	4.83E+01			8.99E+01											
CV or beta (Min Qty, Max Qty)	0.27			0.29											
Quantity Unit:	400 ft^2 Units			400 ft^2 Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.4E+04	LogNormal	0.27	2.2E+04	LogNormal	0.29									
Embodied Energy (MJ)	2.8E+05	LogNormal	0.27	4.3E+05	LogNormal	0.29									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	50% 0.50			25% 0.50											

Comments: Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Andrew Whittaker

Revisions: None

Root Cost Multiplier: 400

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1044.073

NISTIR Name
Description

Low rise reinforced concrete walls with boundary columns, 8" to 16" thick, height between 24'-40"
Costing for each 900 ft^2 Wall Panel, Orthogonal web reinforcement, f'c > 2500 psi, P/(A*f'c) <= 0.2

Line 209

Construction Quality:	Not Specified					Quantity Rounding Round Qty? NO Allow sum by floor or building? NO Demand Location (floor above?) No
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	SF 900					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.		Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.			

Illustrations

				
B1044.061-DS1-1.JPG	B1044.061-DS2-1.JPG			

Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, δ :	0.0033	0.0087			
Data dispersion, β_d :	0.33	0.18			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.35	0.2			
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Superior	

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12# A706 bars in bz ea. end; mech splices to (E) ; b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/dm at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt, finishes, furniture & MEP.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	8.39E+04	8.93E+04	1.02E+05	1.24E+05	1.52E+05	1.82E+05									
Best fit mean:	9.13E+04			1.53E+05											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00			7.00											
Average Repair Cost (Min Qty, Max Qty)	1.12E+05			7.59E+04			1.90E+05			1.29E+05					
CV or beta (Min Qty, Max Qty)	0.08			0.08			0.15			0.15					
Quantity Unit:	900 ft^2 Units			900 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.02E+01	8.53E+01	9.74E+01	1.19E+02	1.45E+02	1.74E+02									
Best fit mean:	8.53E+01			1.45E+02											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00			7.00											
Average Repair Time (Min Qty, Max Qty)	1.07E+02			7.25E+01			1.81E+02			1.23E+02					
CV or beta (Min Qty, Max Qty)	0.26			0.26			0.29			0.29					
Quantity Unit:	900 ft^2 Units			900 ft^2 Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	3.1E+04	LogNormal	0.26	4.5E+04	Normal	0.29									
Embodied Energy (MJ)	6.1E+05	LogNormal	0.26	8.5E+05	Normal	0.29									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%			0%											
Loss of Life (Median, Dispersion)	0%			0%											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	50%			25%											

Comments: Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Andrew Whittaker

Revisions: None

Root Cost Multiplier: 900

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1044.081

NISTIR Name

Low rise reinforced concrete walls with boundary columns, 17"-24" thick, height <15'

Description

Costing for each 144 ft*2 Wall Panel, Orthogonal web reinforcement, $f_c > 2500$ psi, $P/(A*f_c) \leq 0.2$

Line 210

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

SF 144

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	NO	

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.

Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.

Illustrations

				
B1044.061-DS1-1.JPG	B1044.061-DS2-1.JPG			

Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.0033

0.0087

Data dispersion, β_d :

0.33

0.18

Uncertainty, β_u :

0.1

0.1

Total Dispersion, β :

0.35

0.2

Correlation (Yes / No)

NO

Data Quality Average

Documentation Quality Superior

Directionality (Yes / No)

YES

Data Relevance Average

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).
(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12# A706 bars in bz ea. end; mech splices to (E) ; b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/dm at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt, finishes, furniture & MEP.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.69E+04	1.84E+04	2.17E+04	2.97E+04	3.55E+04	4.26E+04									
Best fit mean:	1.89E+04			3.56E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00											
Average Repair Cost (Min Qty, Max Qty)	2.30E+04			4.44E+04											
CV or beta (Min Qty, Max Qty)	0.10			0.14											
Quantity Unit:	144 ft*2 Units			144 ft*2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.32E+01	1.44E+01	1.69E+01	2.31E+01	2.77E+01	3.32E+01									
Best fit mean:	1.44E+01			2.77E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00											
Average Repair Time (Min Qty, Max Qty)	1.79E+01			3.46E+01											
CV or beta (Min Qty, Max Qty)	0.27			0.29											
Quantity Unit:	144 ft*2 Units			144 ft*2 Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.3E+03	LogNormal	0.27	1.1E+04	LogNormal	0.29									
Embodied Energy (MJ)	1.3E+05	LogNormal	0.27	2.1E+05	LogNormal	0.29									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%			0%											
Loss of Life (Median, Dispersion)	0%			0%											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	50%			25%											

Comments:

Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Andrew Whittaker

Revisions:

None

Root Cost Multiplier: 144

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1044.082

NISTIR Name
Description

Low rise reinforced concrete walls with boundary columns, 17"-24" thick, height between 16'-24'
Costing for each 400 ft*2 Wall Panel, Orthogonal web reinforcement, $f_c > 2500$ psi, $P/(A*f_c) \leq 0.2$

Line 211

Construction Quality:	Not Specified					Quantity Rounding Round Qty? NO Allow sum by floor or building? NO Demand Location (floor above?) No
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	SF 400					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.		Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.			

Illustrations

				
B1044.061-DS1-1.JPG	B1044.061-DS2-1.JPG			
1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.0033	0.0087			
Data dispersion, β_d :	0.33	0.18			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.35	0.2			
Correlation (Yes / No)	NO		Data Quality Average	Documentation Quality Superior	
Directionality (Yes / No)	YES		Data Relevance Average	Rationality Superior	

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12# A706 bars in bz ea. end; mech splices to (E) ; b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/dm at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt, finishes, furniture & MEP.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	4.65E+04	5.03E+04	5.79E+04	8.66E+04	9.92E+04	1.18E+05									
Best fit mean:	5.13E+04			1.00E+05											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00			7.00											
Average Repair Cost (Min Qty, Max Qty)	6.29E+04			4.28E+04			1.24E+05			8.43E+04					
CV or beta (Min Qty, Max Qty)	0.09			0.09			0.12			0.12					
Quantity Unit:	400 ft*2 Units			400 ft*2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	4.31E+01	4.66E+01	5.36E+01	8.02E+01	9.19E+01	1.09E+02									
Best fit mean:	4.66E+01			9.19E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00			7.00											
Average Repair Time (Min Qty, Max Qty)	5.83E+01			3.96E+01			1.15E+02			7.81E+01					
CV or beta (Min Qty, Max Qty)	0.26			0.26			0.28			0.28					
Quantity Unit:	400 ft*2 Units			400 ft*2 Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.7E+04	LogNormal	0.26	3.2E+04	LogNormal	0.28									
Embodied Energy (MJ)	3.5E+05	LogNormal	0.26	5.7E+05	LogNormal	0.28									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	50% 0.50			25% 0.50											

Comments: Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Andrew Whittaker

Revisions: None

Root Cost Multiplier: 400

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1044.083

NISTIR Name

Low rise reinforced concrete walls with boundary columns, 17"-24" thick, height between 24'-40'
Costing for each 900 ft^2 Wall Panel, Orthogonal web reinforcement, f'c > 2500 psi, P/(A*f'c) <= 0.2

Description

Line 212

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

SF 900

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	NO	NO

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.

Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.

Illustrations



Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.0033

0.0087

Data dispersion, β_d :

0.33

0.18

Uncertainty, β_u :

0.1

0.1

Total Dispersion, β :

0.35

0.2

Correlation (Yes / No)

NO

Data Quality Average

Documentation Quality Superior

Directionality (Yes / No)

YES

Data Relevance Average

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12# A706 bars in bz ea. end; mech splices to (E) ; b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/dm at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt, finishes, furniture & MEP.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.03E+05	1.09E+05	1.21E+05	1.57E+05	1.93E+05	2.25E+05									
Best fit mean:	1.11E+05			1.92E+05											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00			7.00											
Average Repair Cost (Min Qty, Max Qty)	1.36E+05			9.23E+04			2.42E+05			1.64E+05					
CV or beta (Min Qty, Max Qty)	0.06			0.06			0.14			0.14					
Quantity Unit:	900 ft^2 Units			900 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.86E+01	1.04E+02	1.16E+02	1.50E+02	1.85E+02	2.15E+02									
Best fit mean:	1.04E+02			1.85E+02											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00			7.00											
Average Repair Time (Min Qty, Max Qty)	1.30E+02			8.82E+01			2.31E+02			1.57E+02					
CV or beta (Min Qty, Max Qty)	0.26			0.26			0.29			0.29					
Quantity Unit:	900 ft^2 Units			900 ft^2 Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	3.8E+04	LogNormal	0.26	6.6E+04	Normal	0.29									
Embodied Energy (MJ)	7.6E+05	LogNormal	0.26	1.1E+06	Normal	0.29									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%			0%											
Loss of Life (Median, Dispersion)	0%			0%											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	50%			25%											

Comments:

Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Andrew Whittaker

Revisions:

None

Root Cost Multiplier: 900

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification B1044.091
NISTIR Name Slender Concrete Wall, 12" thick, 12' high, 15' long
Description Slender concrete shear wall with aspect ratio greater than or equal to 2.0. Costing assumes a 144 ft^2 wall panel.

Line 213

Construction Quality:	Not Specified			
Seismic Installation Conditions:	Not applicable			
Fragility Unit of Measure:	SF 144			
Demand Parameter (unit):	Effective Drift			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Spalling of cover, vertical cracks greater than 1/16 inch.	Exposed longitudinal reinforcing.	Core concrete damage, buckled reinforcing, fractured reinforcing, shear failure, web failure, bond slip	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, δ :	0.0093	0.0128	0.0186		
Data dispersion, β_d :	0.465	0.33	0.43		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.5	0.35	0.45		
Correlation (Yes / No)	NO	Data Quality Superior	Documentation Quality Superior		
Directionality (Yes / No)	YES	Data Relevance Superior	Rationality Superior		

Consequence Functions			
Repair Description	Epoxy inject cracks and patch spalled concrete.	Shore wall, remove all concrete in damaged regions, replace concrete.	Replace wall or reinforce with R/C jacket if possible. Shore floor and wall, remove damaged concrete and steel within one development length of damaged region, replace removed concrete and steel.

Long Lead Time (Yes / No) NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	4.40E+03	5.66E+03	9.85E+03	1.64E+04	2.14E+04	3.01E+04	3.66E+04	4.06E+04	5.38E+04						
Best fit mean:	6.20E+03			2.19E+04			4.31E+04								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Cost (Min Qty, Max Qty)	7.07E+03			2.67E+04			5.08E+04								
CV or beta (Min Qty, Max Qty)	0.35			0.24			0.16								
Quantity Unit:	144 ft^2 Units			144 ft^2 Units			144 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	3.43E+00	4.41E+00	7.68E+00	1.28E+01	1.66E+01	2.35E+01	2.85E+01	3.17E+01	4.20E+01						
Best fit mean:	4.41E+00			1.66E+01			3.17E+01								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Time (Min Qty, Max Qty)	5.51E+00			2.08E+01			3.96E+01								
CV or beta (Min Qty, Max Qty)	0.43			0.35			0.30								
Quantity Unit:	144 ft^2 Units			144 ft^2 Units			144 ft^2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.5E+03	LogNormal	0.43	8.5E+03	LogNormal	0.35	8.0E+03	LogNormal	0.30						
Embodied Energy (MJ)	3.5E+04	LogNormal	0.43	1.7E+05	LogNormal	0.35	1.6E+05	LogNormal	0.30						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		25%	0.50		10%	0.50							

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.
Root Cost Multiplier: 144
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification B1044.092
NISTIR Name Slender Concrete Wall, 12" thick, 12' high, 20' long
Description Slender concrete shear wall with aspect ratio greater than or equal to 2.0. Costing assumes a 144 ft^2 wall panel.

Line 214

Construction Quality:	Not Specified				
Seismic Installation Conditions:	Not applicable				
Fragility Unit of Measure:	SF 144				
Demand Parameter (unit):	Effective Drift				
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Spalling of cover, vertical cracks greater than 1/16 inch.	Exposed longitudinal reinforcing.	Core concrete damage, buckled reinforcing, fractured reinforcing, shear failure, web failure, bond slip		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, δ :	0.0093	0.0128	0.0186		
Data dispersion, β_d :	0.465	0.33	0.43		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.5	0.35	0.45		
Correlation (Yes / No)	NO	Data Quality Superior	Documentation Quality Superior		
Directionality (Yes / No)	YES	Data Relevance Superior	Rationality Superior		

Consequence Functions			
Repair Description	Epoxy inject cracks and patch spalled concrete.	Shore wall, remove all concrete in damaged regions, replace concrete.	Replace wall or reinforce with R/C jacket if possible. Shore floor and wall, remove damaged concrete and steel within one development length of damaged region, replace removed concrete and steel.

Long Lead Time (Yes / No) NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	4.14E+03	5.26E+03	8.65E+03	1.32E+04	1.71E+04	2.39E+04	3.58E+04	3.92E+04	5.09E+04						
Best fit mean:	5.70E+03			1.76E+04			4.15E+04								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Cost (Min Qty, Max Qty)	6.57E+03			2.14E+04			4.90E+04								
CV or beta (Min Qty, Max Qty)	0.31			0.24			0.15								
Quantity Unit:	144 ft^2 Units			144 ft^2 Units			144 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	3.23E+00	4.09E+00	6.74E+00	1.03E+01	1.33E+01	1.87E+01	2.79E+01	3.06E+01	3.97E+01						
Best fit mean:	4.09E+00			1.33E+01			3.06E+01								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Time (Min Qty, Max Qty)	5.11E+00			1.67E+01			3.82E+01								
CV or beta (Min Qty, Max Qty)	0.40			0.34			0.29								
Quantity Unit:	144 ft^2 Units			144 ft^2 Units			144 ft^2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.5E+03	LogNormal	0.40	6.8E+03	LogNormal	0.34	7.9E+03	LogNormal	0.29						
Embodied Energy (MJ)	3.5E+04	LogNormal	0.40	1.4E+05	LogNormal	0.34	1.6E+05	LogNormal	0.29						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		25%	0.50		10%	0.50							

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.
Root Cost Multiplier: 144
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification B1044.093
NISTIR Name Slender Concrete Wall, 12" thick, 12' high, 30' long
Description Slender concrete shear wall with aspect ratio greater than or equal to 2.0. Costing assumes a 144 ft^2 wall panel.

Line 215

Construction Quality:	Not Specified			
Seismic Installation Conditions:	Not applicable			
Fragility Unit of Measure:	SF 144			
Demand Parameter (unit):	Effective Drift			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Spalling of cover, vertical cracks greater than 1/16 inch.	Exposed longitudinal reinforcing.	Core concrete damage, buckled reinforcing, fractured reinforcing, shear failure, web failure, bond slip	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, δ :	0.0093	0.0128	0.0186		
Data dispersion, β_d :	0.465	0.33	0.43		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.5	0.35	0.45		
Correlation (Yes / No)	NO	Data Quality Superior	Documentation Quality Superior		
Directionality (Yes / No)	YES	Data Relevance Superior	Rationality Superior		

Consequence Functions			
Repair Description	Epoxy inject cracks and patch spalled concrete.	Shore wall, remove all concrete in damaged regions, replace concrete.	Replace wall or reinforce with R/C jacket if possible. Shore floor and wall, remove damaged concrete and steel within one development length of damaged region, replace removed concrete and steel.

Long Lead Time (Yes / No) NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.88E+03	4.86E+03	7.45E+03	9.08E+03	1.17E+04	1.63E+04	3.49E+04	3.78E+04	4.80E+04						
Best fit mean:	5.18E+03			1.20E+04			3.99E+04								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00	3.00		7.00						
Average Repair Cost (Min Qty, Max Qty)	6.07E+03		4.13E+03	1.46E+04		9.93E+03	4.73E+04		3.22E+04						
CV or beta (Min Qty, Max Qty)	0.27		0.27	0.24		0.24	0.13		0.13						
Quantity Unit:	144 ft^2 Units			144 ft^2 Units			144 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	3.02E+00	3.79E+00	5.80E+00	7.08E+00	9.10E+00	1.27E+01	2.72E+01	2.95E+01	3.75E+01						
Best fit mean:	3.79E+00			9.10E+00			2.95E+01								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00	3.00		7.00						
Average Repair Time (Min Qty, Max Qty)	4.73E+00		3.22E+00	1.14E+01		7.74E+00	3.69E+01		2.51E+01						
CV or beta (Min Qty, Max Qty)	0.37		0.37	0.34		0.34	0.28		0.28						
Quantity Unit:	144 ft^2 Units			144 ft^2 Units			144 ft^2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.5E+03	LogNormal	0.37	4.6E+03	LogNormal	0.34	8.2E+03	LogNormal	0.28						
Embodied Energy (MJ)	3.4E+04	LogNormal	0.37	9.3E+04	LogNormal	0.34	1.7E+05	LogNormal	0.28						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		25%	0.50		10%	0.50							

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.
Root Cost Multiplier: 144
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification B1044.101
NISTIR Name Slender Concrete Wall, 18" thick, 12' high, 15' long
Description Slender concrete shear wall with aspect ratio greater than or equal to 2.0. Costing assumes a 144 ft^2 wall panel.

Line 216

Construction Quality:	Not Specified			
Seismic Installation Conditions:	Not applicable			
Fragility Unit of Measure:	SF 144			
Demand Parameter (unit):	Effective Drift			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Spalling of cover, vertical cracks greater than 1/16 inch.	Exposed longitudinal reinforcing.	Core concrete damage, buckled reinforcing, fractured reinforcing, shear failure, web failure, bond slip	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, δ :	0.0093	0.0128	0.0186		
Data dispersion, β_d :	0.465	0.33	0.43		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.5	0.35	0.45		
Correlation (Yes / No)	NO	Data Quality Superior	Documentation Quality Superior		
Directionality (Yes / No)	YES	Data Relevance Superior	Rationality Superior		

Consequence Functions			
Repair Description	Epoxy inject cracks and patch spalled concrete.	Shore wall, remove all concrete in damaged regions, replace concrete.	Replace wall or reinforce with R/C jacket if possible. Shore floor and wall, remove damaged concrete and steel within one development length of damaged region, replace removed concrete and steel.

Long Lead Time (Yes / No) NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	6.82E+03	8.68E+03	1.35E+04	2.10E+04	3.00E+04	3.69E+04	4.02E+04	4.46E+04	5.86E+04						
Best fit mean:	9.24E+03			2.93E+04			4.71E+04								
Best Fit Distribution:	LogNormal			Normal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Cost (Min Qty, Max Qty)	1.09E+04			3.75E+04			5.57E+04								
CV or beta (Min Qty, Max Qty)	0.28			0.21			0.16								
Quantity Unit:	144 ft^2 Units			144 ft^2 Units			144 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.31E+00	6.77E+00	1.05E+01	1.63E+01	2.34E+01	2.87E+01	3.13E+01	3.47E+01	4.57E+01						
Best fit mean:	6.77E+00			2.34E+01			3.47E+01								
Best Fit Distribution:	LogNormal			Normal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Time (Min Qty, Max Qty)	8.46E+00			2.92E+01			4.34E+01								
CV or beta (Min Qty, Max Qty)	0.38			0.33			0.29								
Quantity Unit:	144 ft^2 Units			144 ft^2 Units			144 ft^2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.7E+03	LogNormal	0.38	1.2E+04	Normal	0.33	1.0E+04	LogNormal	0.29						
Embodied Energy (MJ)	6.4E+04	LogNormal	0.38	2.6E+05	Normal	0.33	2.0E+05	LogNormal	0.29						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		25%	0.50		10%	0.50							

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.
Root Cost Multiplier: 144
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification B1044.102
NISTIR Name Slender Concrete Wall, 18" thick, 12' high, 20' long
Description Slender concrete shear wall with aspect ratio greater than or equal to 2.0. Costing assumes a 144 ft^2 wall panel.

Line 217

Construction Quality:	Not Specified			
Seismic Installation Conditions:	Not applicable			
Fragility Unit of Measure:	SF 144			
Demand Parameter (unit):	Effective Drift			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Spalling of cover, vertical cracks greater than 1/16 inch.	Exposed longitudinal reinforcing.	Core concrete damage, buckled reinforcing, fractured reinforcing, shear failure, web failure, bond slip	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, δ :	0.0093	0.0128	0.0186		
Data dispersion, β_d :	0.465	0.33	0.43		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.5	0.35	0.45		
Correlation (Yes / No)	NO	Data Quality Superior	Documentation Quality Superior		
Directionality (Yes / No)	YES	Data Relevance Superior	Rationality Superior		

Consequence Functions			
Repair Description	Epoxy inject cracks and patch spalled concrete.	Shore wall, remove all concrete in damaged regions, replace concrete.	Replace wall or reinforce with R/C jacket if possible. Shore floor and wall, remove damaged concrete and steel within one development length of damaged region, replace removed concrete and steel.

Long Lead Time (Yes / No) NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	6.56E+03	8.28E+03	1.23E+04	1.73E+04	2.44E+04	3.00E+04	3.93E+04	4.32E+04	5.57E+04						
Best fit mean:	8.71E+03			2.39E+04			4.55E+04								
Best Fit Distribution:	LogNormal			Normal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Cost (Min Qty, Max Qty)	1.04E+04			3.05E+04			5.40E+04								
CV or beta (Min Qty, Max Qty)	0.26			0.21			0.14								
Quantity Unit:	144 ft^2 Units			144 ft^2 Units			144 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.11E+00	6.45E+00	9.56E+00	1.35E+01	1.90E+01	2.34E+01	3.07E+01	3.37E+01	4.34E+01						
Best fit mean:	6.45E+00			1.90E+01			3.37E+01								
Best Fit Distribution:	LogNormal			Normal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Time (Min Qty, Max Qty)	8.06E+00			2.38E+01			4.21E+01								
CV or beta (Min Qty, Max Qty)	0.36			0.32			0.29								
Quantity Unit:	144 ft^2 Units			144 ft^2 Units			144 ft^2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.7E+03	LogNormal	0.36	9.7E+03	Normal	0.32	1.0E+04	LogNormal	0.29						
Embodied Energy (MJ)	6.4E+04	LogNormal	0.36	2.1E+05	Normal	0.32	2.0E+05	LogNormal	0.29						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		25%	0.50		10%	0.50							

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.
Root Cost Multiplier: 144
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification B1044.103
NISTIR Name Slender Concrete Wall, 18" thick, 12' high, 30' long
Description Slender concrete shear wall with aspect ratio greater than or equal to 2.0. Costing assumes a 144 ft^2 wall panel.

Line 218

Construction Quality:	Not Specified			
Seismic Installation Conditions:	Not applicable			
Fragility Unit of Measure:	SF 144			
Demand Parameter (unit):	Effective Drift			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Spalling of cover, vertical cracks greater than 1/16 inch.	Exposed longitudinal reinforcing.	Core concrete damage, buckled reinforcing, fractured reinforcing, shear failure, web failure, bond slip	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, δ :	0.0093	0.0128	0.0186		
Data dispersion, β_d :	0.465	0.33	0.43		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.5	0.35	0.45		
Correlation (Yes / No)	NO	Data Quality Superior	Documentation Quality Superior		
Directionality (Yes / No)	YES	Data Relevance Superior	Rationality Superior		

Consequence Functions			
Repair Description	Epoxy inject cracks and patch spalled concrete.	Shore wall, remove all concrete in damaged regions, replace concrete.	Replace wall or reinforce with R/C jacket if possible. Shore floor and wall, remove damaged concrete and steel within one development length of damaged region, replace removed concrete and steel.

Long Lead Time (Yes / No) NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	6.30E+03	7.88E+03	1.11E+04	1.36E+04	1.89E+04	2.32E+04	3.85E+04	4.19E+04	5.29E+04						
Best fit mean:	8.18E+03			1.86E+04			4.40E+04								
Best Fit Distribution:	LogNormal			Normal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Cost (Min Qty, Max Qty)	9.85E+03			2.36E+04			0.00E+00								
CV or beta (Min Qty, Max Qty)	0.23			0.20			0.13								
Quantity Unit:	144 ft^2 Units			144 ft^2 Units			144 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	4.91E+00	6.15E+00	8.63E+00	1.06E+01	1.47E+01	1.81E+01	3.00E+01	3.26E+01	4.12E+01						
Best fit mean:	6.15E+00			1.47E+01			3.26E+01								
Best Fit Distribution:	LogNormal			Normal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Time (Min Qty, Max Qty)	7.68E+00			1.84E+01			3.26E+01								
CV or beta (Min Qty, Max Qty)	0.34			0.32			0.28								
Quantity Unit:	144 ft^2 Units			144 ft^2 Units			144 ft^2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.7E+03	LogNormal	0.34	7.5E+03	Normal	0.32	1.0E+04	LogNormal	0.28						
Embodied Energy (MJ)	6.3E+04	LogNormal	0.34	1.6E+05	Normal	0.32	2.0E+05	LogNormal	0.28						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		25%	0.50		10%	0.50							

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.

Root Cost Multiplier: 144
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification B1044.111
NISTIR Name Slender Concrete Wall, 30" thick, 12' high, 15' long
Description Slender concrete shear wall with aspect ratio greater than or equal to 2.0. Costing assumes a 144 ft^2 wall panel.

Line 219

Construction Quality:	Not Specified			
Seismic Installation Conditions:	Not applicable			
Fragility Unit of Measure:	SF 144			
Demand Parameter (unit):	Effective Drift Unit less			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Spalling of cover, vertical cracks greater than 1/16 inch.	Exposed longitudinal reinforcing.	Core concrete damage, buckled reinforcing, fractured reinforcing, shear failure, web failure, bond slip	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0093	0.0128	0.0186		
Data dispersion, β_d :	0.465	0.33	0.43		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.5	0.35	0.45		
Correlation (Yes / No)	NO	Data Quality Superior	Documentation Quality Superior		
Directionality (Yes / No)	YES	Data Relevance Superior	Rationality Superior		

Consequence Functions			
Repair Description	Epoxy inject cracks and patch spalled concrete.	Shore wall, remove all concrete in damaged regions, replace concrete.	Replace wall or reinforce with R/C jacket if possible. Shore floor and wall, remove damaged concrete and steel within one development length of damaged region, replace removed concrete and steel.

Long Lead Time (Yes / No) NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.03E+04	1.30E+04	1.87E+04	2.83E+04	4.32E+04	4.80E+04	4.74E+04	5.26E+04	6.82E+04						
Best fit mean:	1.35E+04			3.98E+04			5.54E+04								
Best Fit Distribution:	LogNormal			Normal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Cost (Min Qty, Max Qty)	1.63E+04			5.40E+04			6.58E+04								
CV or beta (Min Qty, Max Qty)	0.24			0.19			0.15								
Quantity Unit:	144 ft^2 Units			144 ft^2 Units			144 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.01E+00	1.01E+01	1.45E+01	2.21E+01	3.37E+01	3.74E+01	3.69E+01	4.10E+01	5.32E+01						
Best fit mean:	1.01E+01			3.37E+01			4.10E+01								
Best Fit Distribution:	LogNormal			Normal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Time (Min Qty, Max Qty)	1.27E+01			4.21E+01			5.12E+01								
CV or beta (Min Qty, Max Qty)	0.35			0.32			0.29								
Quantity Unit:	144 ft^2 Units			144 ft^2 Units			144 ft^2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.5E+03	LogNormal	0.35	1.8E+04	Normal	0.32	1.5E+04	LogNormal	0.29						
Embodied Energy (MJ)	1.1E+05	LogNormal	0.35	3.7E+05	Normal	0.32	2.9E+05	LogNormal	0.29						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		25%	0.50		10%	0.50							

Comments:	None				Root Cost Multiplier:	144
Date Created:	Not Given				Date Generated:	02/26/19
Approved (YES / NO)?	By User					
Official (YES / NO) ?	By User					
Author:	Not Given					
Revisions:	2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.					

FEMA P-58 Fragility Specification

NISTIR Classification B1044.112
NISTIR Name Slender Concrete Wall, 30" thick, 12' high, 20' long
Description Slender concrete shear wall with aspect ratio greater than or equal to 2.0. Costing assumes a 144 ft^2 wall panel.

Line 220

Construction Quality:	Not Specified			
Seismic Installation Conditions:	Not applicable			
Fragility Unit of Measure:	SF 144			
Demand Parameter (unit):	Effective Drift			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Spalling of cover, vertical cracks greater than 1/16 inch.	Exposed longitudinal reinforcing.	Core concrete damage, buckled reinforcing, fractured reinforcing, shear failure, web failure, bond slip	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0093	0.0128	0.0186		
Data dispersion, β_d :	0.465	0.33	0.43		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.5	0.35	0.45		
Correlation (Yes / No)	NO	Data Quality Superior	Documentation Quality Superior		
Directionality (Yes / No)	YES	Data Relevance Superior	Rationality Superior		

Consequence Functions			
Repair Description	Epoxy inject cracks and patch spalled concrete.	Shore wall, remove all concrete in damaged regions, replace concrete.	Replace wall or reinforce with R/C jacket if possible. Shore floor and wall, remove damaged concrete and steel within one development length of damaged region, replace removed concrete and steel.

Long Lead Time (Yes / No) NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.00E+04	1.26E+04	1.75E+04	2.38E+04	3.55E+04	3.98E+04	4.65E+04	5.12E+04	6.53E+04						
Best fit mean:	1.30E+04			3.30E+04			5.38E+04								
Best Fit Distribution:	LogNormal			Normal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Cost (Min Qty, Max Qty)	1.58E+04			4.44E+04			6.40E+04								
CV or beta (Min Qty, Max Qty)	0.22			0.19			0.14								
Quantity Unit:	144 ft^2 Units			144 ft^2 Units			144 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	7.80E+00	9.82E+00	1.36E+01	1.85E+01	2.77E+01	3.10E+01	3.63E+01	3.99E+01	5.09E+01						
Best fit mean:	9.82E+00			2.77E+01			3.99E+01								
Best Fit Distribution:	LogNormal			Normal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Time (Min Qty, Max Qty)	1.23E+01			3.46E+01			4.99E+01								
CV or beta (Min Qty, Max Qty)	0.34			0.31			0.29								
Quantity Unit:	144 ft^2 Units			144 ft^2 Units			144 ft^2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.4E+03	LogNormal	0.34	1.5E+04	Normal	0.31	1.5E+04	LogNormal	0.29						
Embodied Energy (MJ)	1.1E+05	LogNormal	0.34	3.1E+05	Normal	0.31	2.8E+05	LogNormal	0.29						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%			0%			0%								
Loss of Life (Median, Dispersion)	0%			0%			0%								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%			25%			10%								

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.

Root Cost Multiplier: 144
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification B1044.113
NISTIR Name Slender Concrete Wall, 30" thick, 12' high, 30' long
Description Slender concrete shear wall with aspect ratio greater than or equal to 2.0. Costing assumes a 144 ft^2 wall panel.

Line 221

Construction Quality:	Not Specified			
Seismic Installation Conditions:	Not applicable			
Fragility Unit of Measure:	SF 144			
Demand Parameter (unit):	Effective Drift			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Spalling of cover, vertical cracks greater than 1/16 inch.	Exposed longitudinal reinforcing.	Core concrete damage, buckled reinforcing, fractured reinforcing, shear failure, web failure, bond slip	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0093	0.0128	0.0186		
Data dispersion, β_d :	0.465	0.33	0.43		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.5	0.35	0.45		
Correlation (Yes / No)	NO	Data Quality Superior	Documentation Quality Superior		
Directionality (Yes / No)	YES	Data Relevance Superior	Rationality Superior		

Consequence Functions			
Repair Description	Epoxy inject cracks and patch spalled concrete.	Shore wall, remove all concrete in damaged regions, replace concrete.	Replace wall or reinforce with R/C jacket if possible. Shore floor and wall, remove damaged concrete and steel within one development length of damaged region, replace removed concrete and steel.

Long Lead Time (Yes / No) NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	9.76E+03	1.22E+04	1.63E+04	1.92E+04	2.78E+04	3.16E+04	4.57E+04	4.98E+04	6.24E+04						
Best fit mean:	1.25E+04			2.62E+04			5.22E+04								
Best Fit Distribution:	LogNormal			Normal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Cost (Min Qty, Max Qty)	1.53E+04			3.48E+04			6.23E+04								
CV or beta (Min Qty, Max Qty)	0.20			0.18			0.13								
Quantity Unit:	144 ft^2 Units			144 ft^2 Units			144 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	7.60E+00	9.50E+00	1.27E+01	1.50E+01	2.17E+01	2.46E+01	3.56E+01	3.88E+01	4.87E+01						
Best fit mean:	9.50E+00			2.17E+01			3.88E+01								
Best Fit Distribution:	LogNormal			Normal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00			3.00								
Average Repair Time (Min Qty, Max Qty)	1.19E+01			2.71E+01			4.85E+01								
CV or beta (Min Qty, Max Qty)	0.32			0.31			0.28								
Quantity Unit:	144 ft^2 Units			144 ft^2 Units			144 ft^2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.4E+03	LogNormal	0.32	1.1E+04	Normal	0.31	1.5E+04	LogNormal	0.28						
Embodied Energy (MJ)	1.0E+05	LogNormal	0.32	2.4E+05	Normal	0.31	2.8E+05	LogNormal	0.28						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		25%	0.50		10%	0.50							

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.
Root Cost Multiplier: 144
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR ClassificationB1049.001a

NISTIR NameReinforced concrete flat slabs- columns without shear reinforcing 0<Vg/Vo<.2, no continuity reinf

DescriptionCosting per joint, minimum of 6" thick slab, maximum of 12" thick slab.

Line 222

Construction Quality:	Not Specified					Quantity Rounding		Round Qty?	YES	
Seismic Installation Conditions:	Not applicable					Allow sum by floor or building?				NO
Fragility Unit of Measure:	EA 1					Demand Location (floor above)?				No
Demand Parameter (unit):	Story Drift Ratio		Unit less							
Number of Damage States:	2									
Damage State:	DS1		DS2							
Type of Damage State:	Sequential		Sequential							
DS Hierarchy	Seq(DS1,DS2)									
Descriptions	Yield strain of the slab flexural reinforcement has been exceeded, spalling of concrete may/may not occur, slab exhibits large enough crack widths to allow epoxy injection.		Punching occurs, causing significant spalling of concrete. Epoxy injection is no longer expected to be sufficient to restore the required strength and stiffness to the slab and the slab-column connection.							

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

				
B1049.001a-DS1-1.JPG	B1049.001a-DS2-1.JPG			
1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.025	0.04			
Data dispersion, β_d :	0.2	0.20			
Uncertainty, β_u :	0.2	0.2			
Total Dispersion, β :	0.25	0.25			
Correlation (Yes / No)	NO		Data Quality Average	Documentation Quality Average	
Directionality (Yes / No)	NO		Data Relevance Average	Rationality Superior	

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Shore damaged area in the two stories below. Remove 100 square feet of concrete slab per column, preserving the slab reinforcement; lap splice 30 new 10 foot long rebar with existing rebar; place formwork; recast concrete slab; remove forms, replace and repair finishes; replace furnishings, ceilings, mechanical, electrical, and plumbing systems. Cracks wide enough to be grouted are included in the portion of slab to be demolished and recast.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.93E+04	3.62E+04	5.09E+04	3.43E+04	4.95E+04	7.67E+04									
Best fit mean:	3.55E+04			5.06E+04											
Best Fit Distribution:	Normal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00											
Average Repair Cost (Min Qty, Max Qty)	4.53E+04 3.08E+04			6.19E+04 4.21E+04											
CV or beta (Min Qty, Max Qty)	0.35 0.35			0.32 0.32											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.65E+01	3.09E+01	4.34E+01	2.93E+01	4.23E+01	6.54E+01									
Best fit mean:	3.09E+01			4.23E+01											
Best Fit Distribution:	Normal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00											
Average Repair Time (Min Qty, Max Qty)	3.86E+01 2.63E+01			5.28E+01 3.59E+01											
CV or beta (Min Qty, Max Qty)	0.43 0.43			0.41 0.41											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.5E+03	Normal	0.43	6.3E+03	LogNormal	0.41									
Embodied Energy (MJ)	9.6E+04	Normal	0.43	9.6E+04	LogNormal	0.41									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		10%	0.50										

Comments:None
Date Created:Not Given
Approved (YES / NO)?By User
Official (YES / NO) ?By User
Author:John Wallace
Revisions:None

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR ClassificationB1049.001b

NISTIR NameReinforced concrete flat slabs- columns without shear reinforcing 0<Vg/Vo<.2, with continuity reinf

DescriptionCosting per joint, minimum of 6" thick slab, maximum of 12" thick slab.

Line 223

Construction Quality:	Not Specified					Quantity Rounding		Round Qty?	YES	
Seismic Installation Conditions:	Not applicable					Allow sum by floor or building?				NO
Fragility Unit of Measure:	EA 1					Demand Location (floor above)?				No
Demand Parameter (unit):	Story Drift Ratio					Unit less				
Number of Damage States:	2									
Damage State:	DS1		DS2							
Type of Damage State:	Sequential		Sequential							
DS Hierarchy	Seq(DS1,DS2)									
Descriptions	Yield strain of the slab flexural reinforcement has been exceeded, spalling of concrete may/may not occur, slab exhibits large enough crack widths to allow epoxy injection.					Punching occurs, causing significant spalling of concrete. Epoxy injection is no longer expected to be sufficient to restore the required strength and stiffness to the slab and the slab-column connection.				

Illustrations					
					
	B1049.001a-DS1-1.JPG	B1049.001a-DS2-1.JPG			

Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.025	0.04			
Data dispersion, β_d :	0.2	0.20			
Uncertainty, β_u :	0.2	0.2			
Total Dispersion, β :	0.25	0.25			
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Average	
Directionality (Yes / No)	NO	Data Relevance Average		Rationality Superior	

Consequence Functions	
Repair Description	<div>Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).</div> <div>Prepare work area for epoxy injection, inject epoxy into 40 feet of crack (30 feet top, 10 bottom of slab) of crack per 100 square feet of floor panel. Fabricate new structural steel shear head (column capital) that attaches to the column beneath the slab.</div>

Long Lead Time (Yes / No)NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.93E+04	3.62E+04	5.09E+04	2.33E+04	4.02E+04	5.69E+04									
Best fit mean:	3.55E+04			4.01E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00											
Average Repair Cost (Min Qty, Max Qty)	4.53E+04			5.03E+04											
CV or beta (Min Qty, Max Qty)	0.35			0.33											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.65E+01	3.09E+01	4.34E+01	1.99E+01	3.43E+01	4.85E+01									
Best fit mean:	3.09E+01			3.43E+01											
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00											
Average Repair Time (Min Qty, Max Qty)	3.86E+01			4.29E+01											
CV or beta (Min Qty, Max Qty)	0.43			0.41											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.5E+03	Normal	0.43	7.1E+03	Normal	0.41									
Embodied Energy (MJ)	9.6E+04	Normal	0.43	1.8E+05	Normal	0.41									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		20%	0.50										

Comments:None

Date Created:Not Given

Approved (YES / NO)?By User

Official (YES / NO) ?By User

Author:John Wallace

Revisions:None

Root Cost Multiplier:1

Date Generated:02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification B1049.002a
NISTIR Name Reinforced concrete flat slabs- columns without shear reinforcing .2<Vg/Vo<.4, no continuity reinf
Description Costing is on a per joint basis.

Line 224

Construction Quality:	ACI 318-56, ACI 318-63, ACI 318-89, ACI 318-95, ACI 318-99, ACI 318-05					<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not applicable					
Fragility Unit of Measure:	EA 1					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Yield strain of the slab flexural reinforcement has been exceeded, spalling of concrete may/may not occur, slab exhibits large enough crack widths to allow epoxy injection.		Punching occurs, causing significant spalling of concrete. Epoxy injection is no longer expected to be sufficient to restore the required strength and stiffness to the slab and the slab-column connection.			

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

				
B1049.001a-DS1-1.JPG	B1049.001a-DS2-1.JPG			

Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.02	0.035			
Data dispersion, β_d :	0.4	0.40			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Average	
Directionality (Yes / No)	NO	Data Relevance Average		Rationality Superior	

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Shore damaged area in the two stories below. Remove 100 square feet of concrete slab per column, preserving the slab reinforcement; lap splice 30 new 10 foot long rebar with existing rebar; place formwork; recast concrete slab; remove forms, replace and repair finishes; replace furnishings, ceilings, mechanical, electrical, and plumbing systems. Cracks wide enough to be grouted are included in the portion of slab to be demolished and recast.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.93E+04	3.62E+04	5.09E+04	3.43E+04	4.95E+04	7.67E+04									
Best fit mean:	3.55E+04			5.06E+04											
Best Fit Distribution:	Normal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00									
Average Repair Cost (Min Qty, Max Qty)	4.53E+04		3.08E+04	6.19E+04		4.21E+04									
CV or beta (Min Qty, Max Qty)	0.35		0.35	0.32		0.32									
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.65E+01	3.09E+01	4.34E+01	2.93E+01	4.23E+01	6.54E+01									
Best fit mean:	3.09E+01			4.23E+01											
Best Fit Distribution:	Normal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00									
Average Repair Time (Min Qty, Max Qty)	3.86E+01		2.63E+01	5.28E+01		3.59E+01									
CV or beta (Min Qty, Max Qty)	0.43		0.43	0.41		0.41									
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.5E+03	Normal	0.43	6.3E+03	LogNormal	0.41									
Embodied Energy (MJ)	9.6E+04	Normal	0.43	9.6E+04	LogNormal	0.41									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		10%	0.50										

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: John Wallace
Revisions: None

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR ClassificationB1049.002b

NISTIR NameReinforced concrete flat slabs- columns without shear reinforcing .2<Vg/Vo<.4, with continuity reinf

DescriptionCosting is on a per joint basis.

Line 225

Construction Quality:ACI 318-56, ACI 318-63, ACI 318-89, ACI 318-95, ACI 318-99, ACI 318-05

Seismic Installation Conditions:Not applicable

Quantity RoundingRound Qty? YES

Fragility Unit of Measure:EA 1

Allow sum by floor or building? NO

Demand Parameter (unit):Story Drift RatioUnit less

Demand Location (floor above?) No

Number of Damage States:2

Damage State:DS1DS2

Type of Damage State:SequentialSequential

DS HierarchySeq(DS1,DS2)

DescriptionsYield strain of the slab flexural reinforcement has been exceeded, spalling of concrete may/may not occur, slab exhibits large enough crack widths to allow epoxy injection.
Punching occurs, causing significant spalling of concrete. Epoxy injection is no longer expected to be sufficient to restore the required strength and stiffness to the slab and the slab-column connection.



Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.02	0.035			
Data dispersion, β_d :	0.4	0.40			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Average	
Directionality (Yes / No)	NO	Data Relevance Average		Rationality Superior	

Consequence Functions

Repair DescriptionRemove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).
Prepare work area for epoxy injection, inject epoxy into 40 feet of crack (30 feet top, 10 feet bottom of slab) per 100 square feet of floor panel. Fabricate new structural steel shear head (column capital) that attaches to the column beneath the slab.

Long Lead Time (Yes / No)NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.93E+04	3.62E+04	5.09E+04	2.33E+04	4.02E+04	5.69E+04									
Best fit mean:	3.55E+04			4.01E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00											
Average Repair Cost (Min Qty, Max Qty)	4.53E+04			5.03E+04											
CV or beta (Min Qty, Max Qty)	0.35			0.33											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.65E+01	3.09E+01	4.34E+01	1.99E+01	3.43E+01	4.85E+01									
Best fit mean:	3.09E+01			3.43E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00											
Average Repair Time (Min Qty, Max Qty)	3.86E+01			4.29E+01											
CV or beta (Min Qty, Max Qty)	0.43			0.41											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.5E+03	Normal	0.43	7.1E+03	Normal	0.41									
Embodied Energy (MJ)	9.6E+04	Normal	0.43	1.8E+05	Normal	0.41									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		20%	0.50										

Comments:None

Date Created:Not Given

Approved (YES / NO)?By User

Official (YES / NO) ?By User

Author:John Wallace

Revisions:None

Root Cost Multiplier:1

Date Generated:02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification B1049.003a
NISTIR Name Reinforced concrete flat slabs- columns without shear reinforcing .4<Vg/Vo<.6, no continuity reinf
Description Costing is on a per joint basis.

Line 226

Construction Quality: ACI 318-63, ACI 318-83, ACI 318-99, ACI 318-02, CAN3-A23.2-M84, A23.3 & MC-90
Seismic Installation Conditions: Not applicable

Fragility Unit of Measure:	EA 1
Demand Parameter (unit):	Story Drift Ratio
Number of Damage States:	2

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Damage State:	DS1	DS2			
Type of Damage State:	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Yield strain of the slab flexural reinforcement has been exceeded, spalling of concrete may/may not occur, slab exhibits large enough crack widths to allow epoxy injection.	Punching occurs, causing significant spalling of concrete. Epoxy injection is no longer expected to be sufficient to restore the required strength and stiffness to the slab and the slab-column connection.			

Illustrations

				
B1049.001a-DS1-1.JPG	B1049.001a-DS2-1.JPG			
1.00	1.00			

Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.012	0.016			
Data dispersion, β_d :	0.4	0.40			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Average	
Directionality (Yes / No)	NO	Data Relevance Average		Rationality Superior	

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Shore damaged area in the two stories below. Remove 100 square feet of concrete slab per column, preserving the slab reinforcement; lap splice 30 new 10 foot long rebar with existing rebar; place formwork; recast concrete slab; remove forms, replace and repair finishes; replace furnishings, ceilings, mechanical, electrical, and plumbing systems. Cracks wide enough to be grouted are included in the portion of slab to be demolished and recast.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.99E+04	3.68E+04	5.15E+04	3.43E+04	4.95E+04	7.67E+04									
Best fit mean:	3.61E+04			5.06E+04											
Best Fit Distribution:	Normal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00											
Average Repair Cost (Min Qty, Max Qty)	4.60E+04			6.19E+04											
CV or beta (Min Qty, Max Qty)	0.34			0.32											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.70E+01	3.14E+01	4.39E+01	2.93E+01	4.23E+01	6.54E+01									
Best fit mean:	3.14E+01			4.23E+01											
Best Fit Distribution:	Normal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00											
Average Repair Time (Min Qty, Max Qty)	3.93E+01			5.28E+01											
CV or beta (Min Qty, Max Qty)	0.42			0.41											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.7E+03	Normal	0.42	6.3E+03	LogNormal	0.41									
Embodied Energy (MJ)	1.0E+05	Normal	0.42	9.6E+04	LogNormal	0.41									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		10%	0.50										

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: John Wallace
Revisions: None

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR ClassificationB1049.003b

NISTIR NameReinforced concrete flat slabs- columns without shear reinforcing .4<Vg/Vo<.6, with continuity reinf

DescriptionCosting is on a per joint basis.

Line 227

Construction Quality:	ACI 318-63, ACI 318-83, ACI 318-99, ACI 318-02, CAN3-A23.2-M84, A23.3 & MC-90					Quantity Rounding		Round Qty?	YES	
Seismic Installation Conditions:	Not applicable					Allow sum by floor or building?				NO
Fragility Unit of Measure:	EA 1					Demand Location (floor above)?				No
Demand Parameter (unit):	Story Drift Ratio		Unit less							
Number of Damage States:	2									
Damage State:	DS1		DS2							
Type of Damage State:	Sequential		Sequential							
DS Hierarchy	Seq(DS1,DS2)									
Descriptions	Yield strain of the slab flexural reinforcement has been exceeded, spalling of concrete may/may not occur, slab exhibits large enough crack widths to allow epoxy injection.			Punching occurs, causing significant spalling of concrete. Epoxy injection is no longer expected to be sufficient to restore the required strength and stiffness to the slab and the slab-column connection.						

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

				
B1049.001a-DS1-1.JPG	B1049.001a-DS2-1.JPG			
1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.012		0.016		
Data dispersion, β_d :	0.4		0.40		
Uncertainty, β_u :	0.1		0.1		
Total Dispersion, β :	0.4		0.4		
Correlation (Yes / No)	NO		Data Quality Average		Documentation Quality Average
Directionality (Yes / No)	NO		Data Relevance Average		Rationality Superior

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Prepare work area for epoxy injection, inject epoxy into 55 feet of crack (40 feet top, 15 feet bottom of slab) per 100 square feet of floor panel. Fabricate new structural steel shear head (column capital) that attaches to the column beneath the slab.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.99E+04	3.68E+04	5.15E+04	2.39E+04	4.08E+04	5.75E+04									
Best fit mean:	3.61E+04			4.07E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00									
Average Repair Cost (Min Qty, Max Qty)	4.60E+04		3.13E+04	5.10E+04		3.47E+04									
CV or beta (Min Qty, Max Qty)	0.34		0.34	0.32		0.32									
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.70E+01	3.14E+01	4.39E+01	2.04E+01	3.48E+01	4.90E+01									
Best fit mean:	3.14E+01			3.48E+01											
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00									
Average Repair Time (Min Qty, Max Qty)	3.93E+01		2.67E+01	4.35E+01		2.96E+01									
CV or beta (Min Qty, Max Qty)	0.42		0.42	0.41		0.41									
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.7E+03	Normal	0.42	7.4E+03	Normal	0.41									
Embodied Energy (MJ)	1.0E+05	Normal	0.42	1.8E+05	Normal	0.41									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%		0.00	0%		0.00									
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00									
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00	20%		0.50									

Comments:None

Date Created:Not Given

Approved (YES / NO)?By User

Official (YES / NO) ?By User

Author:John Wallace

Revisions:None

Root Cost Multiplier:1

Date Generated:02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification B1049.011

NISTIR Name Reinforced concrete flat slabs- columns with shear reinforcing 0.2<vg/Vo<0.4

Description Costing is on a per joint basis.

Line 228

Construction Quality:	ACI 318-71, ACI 318-95, ACI 318-99, ACI 318-05					<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not applicable					
Fragility Unit of Measure:	EA 1					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Yield strain of the slab flexural reinforcement has been exceeded, spalling of concrete may/may not occur, slab exhibits large enough crack widths to allow epoxy injection.		Punching occurs, causing significant spalling of concrete. Epoxy injection is no longer expected to be sufficient to restore the required strength and stiffness to the slab and the slab-column connection.			

Illustrations

				
B1049.001a-DS1-1.JPG	B1049.001a-DS2-1.JPG			
1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, δ :	0.03	0.048			
Data dispersion, β_d :	0.35	0.46			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO		Data Quality Average	Documentation Quality Average	
Directionality (Yes / No)	NO		Data Relevance Average	Rationality Superior	

Consequence Functions

Repair Description	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Prepare work area for epoxy injection, inject epoxy into 70 feet of crack (50 feet top, 20 feet bottom of slab) per 100 square feet of floor panel. Fabricate new structural steel shear head (column capital) that attaches to the column beneath the slab.
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Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.05E+04	3.74E+04	5.21E+04	2.45E+04	4.14E+04	5.81E+04									
Best fit mean:	3.67E+04			4.13E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00											
Average Repair Cost (Min Qty, Max Qty)	4.68E+04			5.18E+04											
CV or beta (Min Qty, Max Qty)	0.34			0.32											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.75E+01	3.19E+01	4.44E+01	2.09E+01	3.53E+01	4.96E+01									
Best fit mean:	3.19E+01			3.53E+01											
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00											
Average Repair Time (Min Qty, Max Qty)	3.99E+01			4.42E+01											
CV or beta (Min Qty, Max Qty)	0.42			0.40											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.42	7.6E+03	Normal	0.40									
Embodied Energy (MJ)	1.1E+05	Normal	0.42	1.9E+05	Normal	0.40									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		20%	0.50										

Comments: None

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: John Wallace

Revisions: 2011-08-24 DS 2 beta changed from 0.5 to 0.4 to avoid negative probability.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1049.012

NISTIR Name
Description

Reinforced concrete flat slabs- columns with shear reinforcing 0.4<Vg/Voc<.6
Costing is on a per joint basis.

Line 229

Construction Quality: ACI-318-63, ACI-318-05, A23.3 & MC-90
Seismic Installation Conditions: Not applicable

Fragility Unit of Measure:	EA 1
Demand Parameter (unit):	Story Drift Ratio Unit less
Number of Damage States:	2

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Damage State:	DS1	DS2			
Type of Damage State:	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Yield strain of the slab flexural reinforcement has been exceeded, spalling of concrete may/may not occur, slab exhibits large enough crack widths to allow epoxy injection.	Punching occurs, causing significant spalling of concrete. Epoxy injection is no longer expected to be sufficient to restore the required strength and stiffness to the slab and the slab-column connection.			

Illustrations

				
B1049.001a-DS1-1.JPG	B1049.001a-DS2-1.JPG			
1.00	1.00			

Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.022	0.03			
Data dispersion, β_d :	0.4	0.50			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Average	
Directionality (Yes / No)	NO	Data Relevance Average		Rationality Superior	

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Prepare work area for epoxy injection, inject epoxy into 85 feet of crack (60 feet top, 25 feet bottom of slab) per 100 square feet of floor panel. Fabricate new structural steel shear head (column capital) that attaches to the column beneath the slab.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.11E+04	3.80E+04	5.27E+04	2.51E+04	4.20E+04	5.87E+04									
Best fit mean:	3.73E+04			4.19E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00											
Average Repair Cost (Min Qty, Max Qty)	4.75E+04			5.25E+04											
CV or beta (Min Qty, Max Qty)	0.33			0.31											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.80E+01	3.24E+01	4.50E+01	2.14E+01	3.58E+01	5.01E+01									
Best fit mean:	3.24E+01			3.58E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00											
Average Repair Time (Min Qty, Max Qty)	4.05E+01			4.48E+01											
CV or beta (Min Qty, Max Qty)	0.41			0.40											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	5.2E+03	Normal	0.41	7.9E+03	Normal	0.40									
Embodied Energy (MJ)	1.1E+05	Normal	0.41	2.0E+05	Normal	0.40									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		20%	0.50										

Comments:

None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: John Wallace
Revisions: 2011-08-24 DS 2 beta changed from 0.5 to 0.4 to avoid negative probability.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR ClassificationB1049.021a

NISTIR NamePost-tensioned concrete flat slabs- columns without shear reinforcing. 0.2<Vg/Vo<.0.4, no continuity reinf

DescriptionCosting is on a per joint basis.

Line 230

Construction Quality:	ACI-318-77, ACI-318-89, ACI-318-05, IBC-03					Quantity Rounding Round Qty? YES Allow sum by floor or building? NO Demand Location (floor above)? No
Seismic Installation Conditions:	Not applicable					
Fragility Unit of Measure:	EA 1					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Yield strain of the slab flexural reinforcement has been exceeded, spalling of concrete may/may not occur, slab exhibits large enough crack widths to allow epoxy injection.		Punching occurs, causing significant spalling of concrete. Epoxy injection is no longer expected to be sufficient to restore the required strength and stiffness to the slab and the slab-column connection.			

Illustrations

				
B1049.001a-DS1-1.JPG	B1049.001a-DS2-1.JPG			

Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.018	0.03			
Data dispersion, β_d :	0.39	0.34			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Average	
Directionality (Yes / No)	NO	Data Relevance Average		Rationality Superior	

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Shore damaged area in the two stories below. Remove 100 square feet of concrete slab per column, preserving the slab reinforcement; lap splice 30 new 10 foot long rebar with existing rebar; place formwork; recast concrete slab; remove forms, replace and repair finishes; replace furnishings, ceilings, mechanical, electrical, and plumbing systems. Cracks wide enough to be grouted are included in the portion of slab to be demolished and recast.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.87E+04	3.56E+04	5.03E+04	3.43E+04	4.95E+04	7.67E+04									
Best fit mean:	3.49E+04			5.06E+04											
Best Fit Distribution:	Normal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00									
Average Repair Cost (Min Qty, Max Qty)	4.45E+04		3.03E+04	6.19E+04		4.21E+04									
CV or beta (Min Qty, Max Qty)	0.35		0.35	0.32		0.32									
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.60E+01	3.04E+01	4.29E+01	2.93E+01	4.23E+01	6.54E+01									
Best fit mean:	3.04E+01			4.23E+01											
Best Fit Distribution:	Normal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00									
Average Repair Time (Min Qty, Max Qty)	3.80E+01		2.58E+01	5.28E+01		3.59E+01									
CV or beta (Min Qty, Max Qty)	0.43		0.43	0.41		0.41									
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.2E+03	Normal	0.43	6.3E+03	LogNormal	0.41									
Embodied Energy (MJ)	9.0E+04	Normal	0.43	9.6E+04	LogNormal	0.41									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		10%	0.50										

Comments:None

Date Created:Not Given

Approved (YES / NO)?By User

Official (YES / NO) ?By User

Author:John Wallace

Revisions:None

Root Cost Multiplier:1

Date Generated:02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1049.021b

Post-tensioned concrete flat slabs- columns without shear reinforcing. 0.2<Vg/Vo<.0.4, with continuity reinf

Costing is on a per joint basis.

Line 231

Construction Quality:	ACI-318-77, ACI-318-89, ACI-318-05, IBC-03					Quantity Rounding		Round Qty?	YES
Seismic Installation Conditions:	Not applicable					Allow sum by floor or building?		NO	
Fragility Unit of Measure:	EA 1					Demand Location (floor above?)		No	
Demand Parameter (unit):	Story Drift Ratio		Unit less						
Number of Damage States:	2								
Damage State:	DS1		DS2						
Type of Damage State:	Sequential		Sequential						
DS Hierarchy	Seq(DS1,DS2)								
Descriptions	Yield strain of the slab flexural reinforcement has been exceeded, spalling of concrete may/may not occur, slab exhibits large enough crack widths to allow epoxy injection.			Punching occurs, causing significant spalling of concrete. Epoxy injection is no longer expected to be sufficient to restore the required strength and stiffness to the slab and the slab-column connection.					

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

				
B1049.001a-DS1-1.JPG	B1049.001a-DS2-1.JPG			
1.00	1.00			

Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.018	0.03			
Data dispersion, β_d :	0.39	0.34			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO		Data Quality Average		Documentation Quality Average
Directionality (Yes / No)	NO		Data Relevance Average		Rationality Superior

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Prepare work area for epoxy injection, inject epoxy into 25 feet of crack (20 feet top, 5 feet bottom of slab) per 100 square feet of floor panel. Fabricate new structural steel shear head (column capital) that attaches to the column beneath the slab.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.87E+04	3.56E+04	5.03E+04	2.27E+04	3.96E+04	5.63E+04									
Best fit mean:	3.49E+04			3.96E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00									
Average Repair Cost (Min Qty, Max Qty)	4.45E+04		3.03E+04	4.95E+04		3.37E+04									
CV or beta (Min Qty, Max Qty)	0.35		0.35	0.33		0.33									
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.60E+01	3.04E+01	4.29E+01	1.94E+01	3.38E+01	4.80E+01									
Best fit mean:	3.04E+01			3.38E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00									
Average Repair Time (Min Qty, Max Qty)	3.80E+01		2.58E+01	4.23E+01		2.87E+01									
CV or beta (Min Qty, Max Qty)	0.43		0.43	0.42		0.42									
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.2E+03	Normal	0.43	6.9E+03	Normal	0.42									
Embodied Energy (MJ)	9.0E+04	Normal	0.43	1.7E+05	Normal	0.42									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		20%	0.50										

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

John Wallace

None

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR ClassificationB1049.022a

NISTIR NamePost-tensioned concrete flat slabs- columns without shear reinforcing 0.4<Vg/Vo<.0.6, no continuity reinf

DescriptionCosting is on a per joint basis.

Line 232

Construction Quality:	ACI-318-77, ACI-318-83, ACI-318-89, ACI-318-05					Quantity RoundingRound Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No
Seismic Installation Conditions:	Not applicable					
Fragility Unit of Measure:	EA 1					
Demand Parameter (unit):	Story Drift Ratio					
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Yield strain of the slab flexural reinforcement has been exceeded, spalling of concrete may/may not occur, slab exhibits large enough crack widths to allow epoxy injection. Punching occurs, causing significant spalling of concrete. Epoxy injection is no longer expected to be sufficient to restore the required strength and stiffness to the slab and the slab-column connection.					

Illustrations					
	B1049.001a-DS1-1.JPG	B1049.001a-DS2-1.JPG			
Damage State Probability:	1.00	1.00			

Fragility Parameters					
Median Demand, θ :	0.013	0.019			
Data dispersion, β_d :	0.45	0.53			
Uncertainty, β_u :	0.2	0.2			
Total Dispersion, β :	0.5	0.55			
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Average	
Directionality (Yes / No)	NO	Data Relevance Average		Rationality Superior	

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Shore damaged area in the two stories below. Remove 100 square feet of concrete slab per column, preserving the slab reinforcement; lap splice 30 new 10 foot long rebar with existing rebar; place formwork; recast concrete slab; remove forms, replace and repair finishes; replace furnishings, ceilings, mechanical, electrical, and plumbing systems. Cracks wide enough to be grouted are included in the portion of slab to be demolished and recast.

Long Lead Time (Yes / No)NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.93E+04	3.62E+04	5.09E+04	3.43E+04	4.95E+04	7.67E+04									
Best fit mean:	3.55E+04			5.06E+04											
Best Fit Distribution:	Normal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00											
Average Repair Cost (Min Qty, Max Qty)	4.53E+04			6.19E+04											
CV or beta (Min Qty, Max Qty)	0.35			0.32											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.65E+01	3.09E+01	4.34E+01	2.93E+01	4.23E+01	6.54E+01									
Best fit mean:	3.09E+01			4.23E+01											
Best Fit Distribution:	Normal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00											
Average Repair Time (Min Qty, Max Qty)	3.86E+01			5.28E+01											
CV or beta (Min Qty, Max Qty)	0.43			0.41											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.5E+03	Normal	0.43	6.3E+03	LogNormal	0.41									
Embodied Energy (MJ)	9.6E+04	Normal	0.43	9.6E+04	LogNormal	0.41									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		10%	0.50										

Comments:None

Date Created:Not Given

Approved (YES / NO)?By User

Official (YES / NO) ?By User

Author:John Wallace

Revisions:2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.

Root Cost Multiplier:1

Date Generated:02/26/19

FEMA P-58 Fragility Specification

NISTIR ClassificationB1049.022b

NISTIR NamePost-tensioned concrete flat slabs- columns without shear reinforcing 0.4<Vg/Vo<.0.6, with continuity reinf

DescriptionCosting is on a per joint basis.

Line 233

Construction Quality:	ACI-318-77, ACI-318-83, ACI-318-89, ACI-318-05					<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not applicable					
Fragility Unit of Measure:	EA 1					
Demand Parameter (unit):	Story Drift Ratio					
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Yield strain of the slab flexural reinforcement has been exceeded, spalling of concrete may/may not occur, slab exhibits large enough crack widths to allow epoxy injection. Punching occurs, causing significant spalling of concrete. Epoxy injection is no longer expected to be sufficient to restore the required strength and stiffness to the slab and the slab-column connection.					

Illustrations					
					
	B1049.001a-DS1-1.JPG	B1049.001a-DS2-1.JPG			
Damage State Probability:	1.00	1.00			

Fragility Parameters					
Median Demand, θ :	0.013	0.019			
Data dispersion, β_d :	0.45	0.53			
Uncertainty, β_u :	0.2	0.2			
Total Dispersion, β :	0.5	0.55			
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Average	
Directionality (Yes / No)	NO	Data Relevance Average		Rationality Superior	

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Prepare work area for epoxy injection, inject epoxy into 40 feet of crack (30 feet top, 10 feet bottom of slab) per 100 square feet of floor panel. Fabricate new structural steel shear head (column capital) that attaches to the column beneath the slab.

Long Lead Time (Yes / No)NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.93E+04	3.62E+04	5.09E+04	2.33E+04	4.02E+04	5.69E+04									
Best fit mean:	3.55E+04			4.01E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00									
Average Repair Cost (Min Qty, Max Qty)	4.35E+04		2.90E+04	4.83E+04		3.22E+04									
CV or beta (Min Qty, Max Qty)	0.35		0.35	0.33		0.33									
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.65E+01	3.09E+01	4.34E+01	1.99E+01	3.43E+01	4.85E+01									
Best fit mean:	3.09E+01			3.43E+01											
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00									
Average Repair Time (Min Qty, Max Qty)	3.71E+01		2.47E+01	4.12E+01		2.75E+01									
CV or beta (Min Qty, Max Qty)	0.43		0.43	0.41		0.41									
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.5E+03	Normal	0.43	7.1E+03	Normal	0.41									
Embodied Energy (MJ)	9.6E+04	Normal	0.43	1.8E+05	Normal	0.41									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		20%	0.50										

Comments:None

Date Created:Not Given

Approved (YES / NO)?By User

Official (YES / NO) ?By User

Author:John Wallace

Revisions:2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.

Root Cost Multiplier:1

Date Generated:02/26/19

FEMA P-58 Fragility Specification

NISTIR ClassificationB1049.031

NISTIR NamePost-tensioned concrete flat slabs- columns with shear reinforcing 0<Vg/Vo<0.4

DescriptionCosting is on a per joint basis.

Line 234

Construction Quality:	Not Specified					Quantity Rounding		Round Qty?	YES		
Seismic Installation Conditions:	Not applicable					Allow sum by floor or building?				NO	
Fragility Unit of Measure:	EA 1					Demand Location (floor above?)					No
Demand Parameter (unit):	Story Drift Ratio					Unit less					
Number of Damage States:	2										
Damage State:	DS1					DS2					
Type of Damage State:	Sequential					Sequential					
DS Hierarchy	Seq(DS1,DS2)										
Descriptions	Yield strain of the slab flexural reinforcement has been exceeded, spalling of concrete may/may not occur, slab exhibits large enough crack widths to allow epoxy injection.					Punching occurs, causing significant spalling of concrete. Epoxy injection is no longer expected to be sufficient to restore the required strength and stiffness to the slab and the slab-column connection.					

Illustrations					
					
	B1049.001a-DS1-1.JPG	B1049.001a-DS2-1.JPG			

Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.028	0.04			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	0.5	0.5			
Total Dispersion, β :	0.5	0.5			
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Superior	
Directionality (Yes / No)	NO	Data Relevance Average		Rationality Superior	

Consequence Functions					
Repair Description	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).				
	Prepare work area for epoxy injection, inject epoxy into 45 feet of crack (35 feet top, 10 feet bottom of slab) per 100 square feet of floor panel. Fabricate new structural steel shear head (column capital) that attaches to the column beneath the slab.				

Long Lead Time (Yes / No)NO

	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Costs:															
Repair Cost by Damage State:	1.95E+04	3.64E+04	5.11E+04	2.35E+04	4.04E+04	5.71E+04									
Best fit mean:	3.57E+04			4.03E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00											
Average Repair Cost (Min Qty, Max Qty)	4.37E+04			4.85E+04											
CV or beta (Min Qty, Max Qty)	0.35			0.32											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.66E+01	3.11E+01	4.36E+01	2.00E+01	3.45E+01	4.87E+01									
Best fit mean:	3.11E+01			3.45E+01											
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00											
Average Repair Time (Min Qty, Max Qty)	3.73E+01			4.14E+01											
CV or beta (Min Qty, Max Qty)	0.43			0.41											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.5E+03	Normal	0.43	7.2E+03	Normal	0.41									
Embodied Energy (MJ)	9.8E+04	Normal	0.43	1.8E+05	Normal	0.41									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		20%	0.50										

Comments: Fragilities were based on judgment due to lack of test data.

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: John Wallace

Revisions: None

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1049.032

Post-tensioned concrete flat slabs- columns with shear reinforcing 0.4<Vg/Vo<0.6

Costing is on a per joint basis.

Line 235

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not applicable

EA 1

Story Drift Ratio

2

DS1

Sequential

Seq(DS1,DS2)

Yield strain of the slab flexural reinforcement has been exceeded, spalling of concrete may/may not occur, slab exhibits large enough crack widths to allow epoxy injection.

Not Specified

DS2

Sequential

Punching occurs, causing significant spalling of concrete. Epoxy injection is no longer expected to be sufficient to restore the required strength and stiffness to the slab and the slab-column connection.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations





B1049.001a-DS1-1.JPG

B1049.001a-DS2-1.JPG

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.00

1.00

0.023

Not Specified

0.5

0.5

NO

NO

Data Quality

Not Rated

Documentation Quality

Average

Data Relevance

Marginal

Rationality

Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Prepare work area for epoxy injection, inject epoxy into 60 feet of crack (45 feet top, 15 feet bottom of slab) per 100 square feet of floor panel. Fabricate new structural steel shear head (column capital) that attaches to the column beneath the slab.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

2.01E+04

3.70E+04

5.17E+04

P₁₀

P₅₀

P₉₀

2.41E+04

4.10E+04

5.77E+04

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

3.63E+04

Normal

7.00

P₁₀

P₅₀

P₉₀

4.09E+04

Normal

7.00

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

3.00

7.00

P₁₀

P₅₀

P₉₀

3.00

7.00

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

4.44E+04

2.96E+04

4.92E+04

P₁₀

P₅₀

P₉₀

3.28E+04

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

0.34

0.34

0.32

P₁₀

P₅₀

P₉₀

Each

Each

0.32

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.71E+01

3.16E+01

4.41E+01

P₁₀

P₅₀

P₉₀

2.06E+01

3.50E+01

4.92E+01

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

3.16E+01

Normal

7.00

P₁₀

P₅₀

P₉₀

3.50E+01

Normal

7.00

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

3.00

7.00

P₁₀

P₅₀

P₉₀

3.00

7.00

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

3.79E+01

2.53E+01

4.20E+01

P₁₀

P₅₀

P₉₀

2.80E+01

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

0.42

0.42

0.41

P₁₀

P₅₀

P₉₀

Each

Each

0.41

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Median Cost

Best Fit

CV or Beta

4.8E+03

Normal

0.42

Median Cost

Best Fit

CV or Beta

7.5E+03

Normal

0.41

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

1.0E+05

Normal

0.42

Median Cost

Best Fit

CV or Beta

1.9E+05

Normal

0.41

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

NO

YES

0%

0.00

20%

0.50

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

Fragilities were based on judgment due to lack of test data.

Not Given

By User

By User

John Wallace

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1049.041a

Reinforced concrete flat slabs drop panel or drop capital- columns without shear reinforcing 0<Vg/Vo<0.4, no continuity reinf

Costing is on a per joint basis.

Line 236

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not applicable

EA 1

Story Drift Ratio

2

DS1

Sequential

Seq(DS1,DS2)

Yield strain of the slab flexural reinforcement has been exceeded.

Punching occurs causing significant spalling of concrete.

Spalling of concrete may or may not occur. Slab exhibits large enough crack widths to allow epoxy injection.

Illustrations



B1049.041a-DS1-1.JPG



B1049.041a-DS2-1.JPG

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_θ :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.00

1.00

0.025

Not Specified

0.5

0.5

NO

NO

Data Quality

Marginal

Documentation Quality

Average

Data Relevance

Marginal

Rationality

Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Shore damaged area in the two stories below. Remove 100 square feet of concrete slab per column, preserving the slab reinforcement; lap splice 30 new 10 foot long rebar with existing rebar; place formwork; recast concrete slab; remove forms, replace and repair finishes; replace furnishings, ceilings, mechanical, electrical, and plumbing systems. Cracks wide enough to be grouted are included in the portion of slab to be demolished and recast.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Time:

Environmental Impacts:

LifeSafety Hazard:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.93E+04

3.62E+04

5.09E+04

3.43E+04

4.95E+04

7.67E+04

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.65E+01

3.09E+01

4.34E+01

2.93E+01

4.23E+01

6.54E+01

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

4.5E+03

Normal

0.43

6.3E+03

LogNormal

0.41

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

YES

10%

0.50

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

Fragilities were based on judgment due to lack of test data. The only available data were from a specimen that was constructed using ACI 318-89

Not Given

By User

By User

John Wallace

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1049.041b

NISTIR Name

Reinforced concrete flat slabs drop panel or drop capital- columns without shear reinforcing 0<Vg/Vo<0.4, with continuity reinf

Description

Costing is on a per joint basis.

Line 237

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not applicable

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Yield strain of the slab flexural reinforcement has been exceeded. Spalling of concrete may or may not occur. Slab exhibits large enough crack widths to allow epoxy injection.

Punching occurs causing significant spalling of concrete.

Illustrations



Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.025

0.042

Data dispersion, β_d :

Not Specified

Not Specified

Uncertainty, β_u :

0.5

0.5

Total Dispersion, β :

0.5

0.5

Correlation (Yes / No)

NO

Data Quality Marginal

Documentation Quality Average

Directionality (Yes / No)

NO

Data Relevance Marginal

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Prepare work area for epoxy injection, inject epoxy into 40 feet of crack (30 feet top, 10 feet bottom of slab) per 100 square feet of floor panel. Fabricate new structural steel shear head (column capital) that attaches to the column beneath the slab.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.93E+04	3.62E+04	5.09E+04	2.33E+04	4.02E+04	5.69E+04									
Best fit mean:	3.55E+04			4.01E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00											
Average Repair Cost (Min Qty, Max Qty)	4.35E+04			4.83E+04											
CV or beta (Min Qty, Max Qty)	0.35			0.33											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.65E+01	3.09E+01	4.34E+01	1.99E+01	3.43E+01	4.85E+01									
Best fit mean:	3.09E+01			3.43E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00											
Average Repair Time (Min Qty, Max Qty)	3.71E+01			4.12E+01											
CV or beta (Min Qty, Max Qty)	0.43			0.41											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.5E+03	Normal	0.43	7.1E+03	Normal	0.41									
Embodied Energy (MJ)	9.6E+04	Normal	0.43	1.8E+05	Normal	0.41									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		20%	0.50										

Comments:

Fragilities were based on judgment due to lack of test data. The only available data were from a specimen that was constructed using ACI 318-89

Date Created:

Not Given

Root Cost Multiplier: 1

Approved (YES / NO)?

By User

Date Generated: 02/26/19

Official (YES / NO) ?

By User

Author:

John Wallace

Revisions:

None

FEMA P-58 Fragility Specification

NISTIR Classification

B1049.042a

NISTIR Name

Reinforced concrete flat slabs drop panel or drop capital- columns without shear reinforcing 0.4<Vg/Vo<0.6, no continuity reinf

Description

Costing is on a per joint basis.

Line 238

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not applicable

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Yield strain of the slab flexural reinforcement has been exceeded. Spalling of concrete may or may not occur. Slab exhibits large enough crack widths to allow epoxy injection.

Punching occurs causing significant spalling of concrete.

Illustrations



Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.017

0.023

Data dispersion, β_d :

Not Specified

Not Specified

Uncertainty, β_u :

0.5

0.5

Total Dispersion, β :

0.5

Correlation (Yes / No)

NO

Data Quality Not Rated

Documentation Quality Average

Directionality (Yes / No)

NO

Data Relevance Marginal

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Shore damaged area in the two stories below. Remove 100 square feet of concrete slab per column, preserving the slab reinforcement; lap splice 30 new 10 foot long rebar with existing rebar; place formwork; recast concrete slab; remove forms, replace and repair finishes; replace furnishings, ceilings, mechanical, electrical, and plumbing systems. Cracks wide enough to be grouted are included in the portion of slab to be demolished and recast.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.99E+04	3.68E+04	5.15E+04	3.43E+04	4.95E+04	7.67E+04									
Best fit mean:	3.61E+04			5.06E+04											
Best Fit Distribution:	Normal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00											
Average Repair Cost (Min Qty, Max Qty)	4.42E+04			5.94E+04											
CV or beta (Min Qty, Max Qty)	0.34			0.32											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.70E+01	3.14E+01	4.39E+01	2.93E+01	4.23E+01	6.54E+01									
Best fit mean:	3.14E+01			4.23E+01											
Best Fit Distribution:	Normal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00											
Average Repair Time (Min Qty, Max Qty)	3.77E+01			5.07E+01											
CV or beta (Min Qty, Max Qty)	0.42			0.41											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.7E+03	Normal	0.42	6.3E+03	LogNormal	0.41									
Embodied Energy (MJ)	1.0E+05	Normal	0.42	9.6E+04	LogNormal	0.41									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		10%	0.50										

Comments:

Fragilities were based on judgment due to lack of test data.

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

John Wallace

Revisions:

None

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1049.042b

Reinforced concrete flat slabs drop panel or drop capital- columns without shear reinforcing 0.4<Vg/Vo<0.6, with continuity reinf

Costing is on a per joint basis.

Line 239

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not applicable

EA 1

Story Drift Ratio

2

DS1

Sequential

Seq(DS1,DS2)

Yield strain of the slab flexural reinforcement has been exceeded.

Punching occurs causing significant spalling of concrete.

Spalling of concrete may or may not occur. Slab exhibits large enough crack widths to allow epoxy injection.

Illustrations



B1049.042a-DS1-1.JPG



B1049.042a-DS2-1.JPG

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.00

1.00

0.017

Not Specified

0.5

0.5

NO

NO

Data Quality

Not Rated

Documentation Quality

Average

Data Relevance

Marginal

Rationality

Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Prepare work area for epoxy injection, inject epoxy into 55 feet of crack (40 feet top, 15 feet bottom of slab) per 100 square feet of floor panel. Fabricate new structural steel shear head (column capital) that attaches to the column beneath the slab.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Time:

Environmental Impacts:

LifeSafety Hazard:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.99E+04

3.68E+04

5.15E+04

Normal

3.00

7.00

4.42E+04

2.95E+04

0.34

0.34

Each

P₁₀

P₅₀

P₉₀

2.39E+04

4.08E+04

5.75E+04

Normal

3.00

7.00

4.90E+04

3.27E+04

0.32

0.32

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.70E+01

3.14E+01

4.39E+01

Normal

3.00

7.00

3.77E+01

2.51E+01

0.42

0.42

Each

P₁₀

P₅₀

P₉₀

2.04E+01

3.48E+01

4.90E+01

Normal

3.00

7.00

4.18E+01

2.79E+01

0.41

0.41

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

4.7E+03

Normal

0.42

Median Cost

Best Fit

CV or Beta

7.4E+03

Normal

0.41

Median Cost

Best Fit

CV or Beta

1.0E+05

Normal

0.42

Median Cost

Best Fit

CV or Beta

1.8E+05

Normal

0.41

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

YES

20%

0.50

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

Fragilities were based on judgment due to lack of test data.

Not Given

By User

By User

John Wallace

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

Root Cost Multiplier: 100
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1051.002

NISTIR Name
Description

Ordinary reinforced masonry walls with partially grouted cells, shear dominated, 4" to 6" thick, greater than 12 foot tall
Costing for each 225 ft^2 Wall Panel

Line 253

Construction Quality: Not Specified
Seismic Installation Conditions: Not Specified

Fragility Unit of Measure: SF 225
Demand Parameter (unit): Story Drift Ratio Unit less
Number of Damage States: 2

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Damage State:	DS1	DS2			
Type of Damage State:	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	First occurrence of major diagonal cracks. Cracks remain closed with hardly noticeable residual crack widths after load removal.				
	Wide diagonal cracks with typically one or more cracks in each direction. Crushing or spalling at wall toes.				

Illustrations



Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, δ :	0.002	0.0033			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	0.86	0.77			
Total Dispersion, β :	0.86	0.77			
Correlation (Yes / No)	NO	Data Quality Marginal		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Superior	

Consequence Functions
Repair Description

Grout wall. Epoxy injection. Paint each side. Shore. Demolish existing wall. Construct new wall.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	7.38E+03	8.20E+03	9.08E+03	9.60E+03	1.24E+04	1.35E+04									
Best fit mean:	8.19E+03			1.18E+04											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	1.00 14.00			1.00 14.00											
Average Repair Cost (Min Qty, Max Qty)	9.84E+03 6.56E+03			1.49E+04 9.90E+03											
CV or beta (Min Qty, Max Qty)	0.08 0.08			0.13 0.13											
Quantity Unit:	225 ft^2 Units			225 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	6.30E+00	7.00E+00	7.74E+00	8.19E+00	1.06E+01	1.15E+01									
Best fit mean:	7.00E+00			1.06E+01											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	1.00 14.00			1.00 14.00											
Average Repair Time (Min Qty, Max Qty)	8.40E+00 5.60E+00			1.27E+01 8.44E+00											
CV or beta (Min Qty, Max Qty)	0.26 0.26			0.28 0.28											
Quantity Unit:	225 ft^2 Units			225 ft^2 Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.1E+03	LogNormal	0.26	4.3E+03	Normal	0.28									
Embodied Energy (MJ)	2.5E+04	LogNormal	0.26	6.5E+04	Normal	0.28									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			25% 0.50											

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Benson Shing
Revisions: None

Root Cost Multiplier: 225
Date Generated: 02/26/19

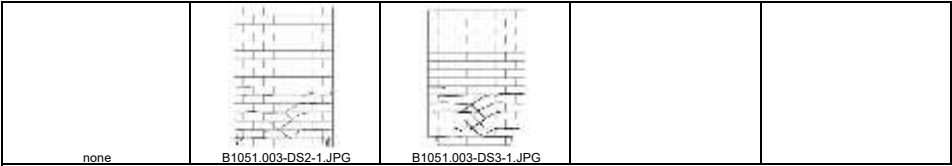
FEMA P-58 Fragility Specification

NISTIR Classification B1051.003
NISTIR Name Ordinary reinforced masonry walls with partially grouted cells, 4" to 6" thick, flexure dominated up to 12' tall
Description Costing for each 100 ft*2 Wall Panel

Line 254

Construction Quality:	Not Specified					Quantity Rounding Round Qty? NO Allow sum by floor or building? NO Demand Location (floor above?) No
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	SF 100					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	3					
Damage State:	DS1		DS2		DS3	
Type of Damage State:	Sequential		Sequential		Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)					
Descriptions	A few flexural and shear cracks with hardly noticeable residual crack widths. Slight yielding of extreme vertical reinforcement. No spalling. No fracture or buckling of vertical reinforcement. No structurally significant damage.		Numerous flexural and diagonal cracks with residual crack widths less than 1/64 in. Mild toe crushing with vertical cracks or light spalling at wall toes. No fracture or buckling of reinforcement. Small residual deformation.		Severe flexural cracks with residual crack widths greater than 1/32 in. Severe toe crushing and spalling. Fracture or buckling of vertical reinforcement. Significant residual deformation.	

Illustrations



Damage State Probability:	1.00				
Fragility Parameters					
Median Demand, δ :	0.0018	0.0051	0.0086		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	0.73	0.65	0.56		
Total Dispersion, β :	0.73	0.65	0.56		
Correlation (Yes / No)	NO	Data Quality Not Rated	Documentation Quality Average		
Directionality (Yes / No)	YES	Data Relevance Marginal	Rationality Superior		

Consequence Functions

Repair Description	Cosmetic repair. Patch cracks and paint each side.	Remove loose masonry. Patch spalls with non-shrink grout. Grout wall. Epoxy injection. Paint each side.	Shore. - Demolish existing wall. - Construct new wall.
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Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.67E+02	6.00E+02	9.33E+02	3.65E+03	4.20E+03	4.78E+03	4.65E+03	6.00E+03	6.75E+03						
Best fit mean:	5.91E+02			4.21E+03			5.80E+03								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	2.00 30.00			2.00 30.00			2.00 30.00								
Average Repair Cost (Min Qty, Max Qty)	7.20E+02 4.80E+02			5.04E+03 3.36E+03			7.20E+03 4.80E+03								
CV or beta (Min Qty, Max Qty)	0.36 0.36			0.11 0.11			0.14 0.14								
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.90E-01	4.70E-01	7.30E-01	2.84E+00	3.27E+00	3.73E+00	3.62E+00	4.68E+00	5.26E+00						
Best fit mean:	4.70E-01			3.27E+00			4.68E+00								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	2.00 30.00			2.00 30.00			2.00 30.00								
Average Repair Time (Min Qty, Max Qty)	5.64E-01 3.76E-01			3.92E+00 2.62E+00			5.62E+00 3.74E+00								
CV or beta (Min Qty, Max Qty)	0.44 0.44			0.27 0.27			0.29 0.29								
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.2E+02	LogNormal	0.44	5.0E+02	Normal	0.27	1.3E+03	Normal	0.29						
Embodied Energy (MJ)	2.8E+03	LogNormal	0.44	1.2E+04	Normal	0.27	2.6E+04	Normal	0.29						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		25%	0.50							



Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Benson Shing
Revisions: None
Root Cost Multiplier: 100
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification B1051.004
NISTIR Name Ordinary reinforced masonry walls with partially grouted cells, 4" to 6" thick, flexure dominated greater than 12' tall
Description Costing for each 225 ft^2 Wall Panel

Line 255

Construction Quality:	Not Specified					<div>Quantity RoundingRound Qty? NO Allow sum by floor or building? NO Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	SF 225					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	3					
Damage State:	DS1		DS2		DS3	
Type of Damage State:	Sequential		Sequential		Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)					
Descriptions	A few flexural and shear cracks with hardly noticeable residual crack widths. Slight yielding of extreme vertical reinforcement. No spalling. No fracture or buckling of vertical reinforcement. No structurally significant damage.		Numerous flexural and diagonal cracks with residual crack widths less than 1/64 in. Mild toe crushing with vertical cracks or light spalling at wall toes. No fracture or buckling of reinforcement. Small residual deformation.		Severe flexural cracks with residual crack widths greater than 1/32 in. Severe toe crushing and spalling. Fracture or buckling of vertical reinforcement. Significant residual deformation.	

Illustrations					
	none	B1051.003-DS2-1.JPG	B1051.003-DS3-1.JPG		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, δ :	0.0018	0.0051	0.0086		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	0.73	0.65	0.56		
Total Dispersion, β :	0.73	0.65	0.56		

Correlation (Yes / No)	NO	Data Quality	Not Rated	Documentation Quality	Average
Directionality (Yes / No)	YES	Data Relevance	Marginal	Rationality	Superior

Consequence Functions	
Repair Description	Cosmetic repair. Patch cracks and paint each side. Remove loose masonry. Patch spalls with non-shrink grout. Grout wall. Epoxy injection. Paint each side. Shore. - Demolish existing wall. - Construct new wall.

Long Lead Time (Yes / No) NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	8.25E+02	1.35E+03	2.10E+03	7.38E+03	8.20E+03	9.08E+03	9.60E+03	1.24E+04	1.35E+04						
Best fit mean:	1.33E+03 LogNormal			8.19E+03 LogNormal			1.18E+04 Normal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	1.00 14.00			1.00 14.00			1.00 14.00								
Average Repair Cost (Min Qty, Max Qty)	1.62E+03 1.08E+03			9.84E+03 6.56E+03			1.49E+04 9.90E+03								
CV or beta (Min Qty, Max Qty)	0.36 0.36			0.08 0.08			0.13 0.13								
Quantity Unit:	225 ft^2 Units			225 ft^2 Units			225 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	6.98E-01	1.15E+00	1.80E+00	6.30E+00	7.00E+00	7.74E+00	8.19E+00	1.06E+01	1.15E+01						
Best fit mean:	1.15E+00 LogNormal			7.00E+00 LogNormal			1.06E+01 Normal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	1.00 14.00			1.00 14.00			1.00 14.00								
Average Repair Time (Min Qty, Max Qty)	1.38E+00 9.17E-01			8.40E+00 5.60E+00			1.27E+01 8.44E+00								
CV or beta (Min Qty, Max Qty)	0.44 0.44			0.26 0.26			0.28 0.28								
Quantity Unit:	225 ft^2 Units			225 ft^2 Units			225 ft^2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.7E+02	LogNormal	0.44	1.1E+03	LogNormal	0.26	4.3E+03	Normal	0.28						
Embodied Energy (MJ)	6.3E+03	LogNormal	0.44	2.5E+04	LogNormal	0.26	6.5E+04	Normal	0.28						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			25% 0.50								

Comments:	None	Root Cost Multiplier:	225
Date Created:	Not Given	Date Generated:	02/26/19
Approved (YES / NO)?	By User		
Official (YES / NO) ?	By User		
Author:	Benson Shing		
Revisions:	None		

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1051.011

Ordinary reinforced masonry walls with partially grouted cells, shear dominated, 8" to 12" thick, up to 12 foot tall

Costing for each 100 ft*2 Wall Panel

Line 256

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

SF 100

Story Drift Ratio

2

DS1

Sequential

Seq(DS1,DS2)

First occurrence of major diagonal cracks. Cracks remain closed with hardly noticeable residual crack widths after load removal.

Not Specified

DS2

Sequential

Wide diagonal cracks with typically one or more cracks in each direction. Crushing or spalling at wall toes.

Quantity Rounding

Round Qty?

NO

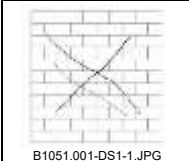
Allow sum by floor or building?

NO

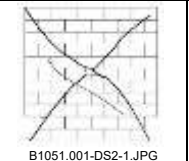
Demand Location (floor above?)

No

Illustrations



B1051.001-DS1-1.JPG



B1051.001-DS2-1.JPG

Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.002

Not Specified

0.86

0.86

0.0033

Not Specified

0.77

0.77

Not Rated

Marginal

Average

Superior

Consequence Functions

Repair Description

Grout wall. Epoxy injection. Paint each side. Shore. Demolish existing wall. Construct new wall.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

3.80E+03

4.35E+03

4.93E+03

Normal

2.00

30.00

5.22E+03

3.48E+03

0.10

0.10

100 ft*2 Units

P₁₀

P₅₀

P₉₀

5.78E+03

7.63E+03

8.38E+03

Normal

2.00

30.00

9.16E+03

6.11E+03

0.14

0.14

100 ft*2 Units

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

2.96E+00

3.39E+00

3.85E+00

Normal

2.00

30.00

4.07E+00

2.71E+00

0.27

0.27

100 ft*2 Units

P₁₀

P₅₀

P₉₀

4.51E+00

5.95E+00

6.53E+00

Normal

2.00

30.00

7.14E+00

4.76E+00

0.29

0.29

100 ft*2 Units

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

5.6E+02

Normal

0.27

Median Cost

Best Fit

CV or Beta

3.1E+03

Normal

0.29

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

YES

25%

0.50

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Benson Shing

None

Root Cost Multiplier:

100

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1051.012

Ordinary reinforced masonry walls with partially grouted cells, shear dominated, 8" to 12" thick, greater than 12 foot tall

Costing for each 225 ft^2 Wall Panel

Line 257

Construction Quality:	Not Specified					Quantity Rounding Round Qty? NO Allow sum by floor or building? NO Demand Location (floor above)? No
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	SF 225					
Demand Parameter (unit):	Story Drift Ratio Unit less					
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	First occurrence of major diagonal cracks. Cracks remain closed with hardly noticeable residual crack widths after load removal.		Wide diagonal cracks with typically one or more cracks in each direction. Crushing or spalling at wall toes.			

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	No	

Illustrations



Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, δ :	0.002	0.0033			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	0.86	0.77			
Total Dispersion, β :	0.86	0.77			
Correlation (Yes / No)	NO	Data Quality Not Rated		Documentation Quality Average	
Directionality (Yes / No)	YES	Data Relevance Marginal		Rationality Superior	

Consequence Functions
Repair Description

Grout wall. Epoxy injection. Paint each side. Shore. Demolish existing wall. Construct new wall.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	7.71E+03	8.54E+03	9.41E+03	1.19E+04	1.58E+04	1.67E+04									
Best fit mean:	8.53E+03			1.48E+04											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	1.00 14.00			1.00 14.00											
Average Repair Cost (Min Qty, Max Qty)	1.02E+04 6.83E+03			1.90E+04 1.26E+04											
CV or beta (Min Qty, Max Qty)	0.08 0.08			0.13 0.13											
Quantity Unit:	225 ft^2 Units			225 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	6.57E+00	7.29E+00	8.03E+00	1.01E+01	1.35E+01	1.42E+01									
Best fit mean:	7.29E+00			1.35E+01											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	1.00 14.00			1.00 14.00											
Average Repair Time (Min Qty, Max Qty)	8.75E+00 5.83E+00			1.62E+01 1.08E+01											
CV or beta (Min Qty, Max Qty)	0.26 0.26			0.28 0.28											
Quantity Unit:	225 ft^2 Units			225 ft^2 Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.2E+03	LogNormal	0.26	7.0E+03	Normal	0.28									
Embodied Energy (MJ)	2.9E+04	LogNormal	0.26	1.0E+05	Normal	0.28									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		25%	0.50										

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Benson Shing

None

Root Cost Multiplier: 225

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR ClassificationB1051.013

NISTIR NameOrdinary reinforced masonry walls with partially grouted cells, 8" to 12" thick, flexure dominated up to 12' tall

DescriptionCosting for each 100 ft*2 Wall Panel,

Line 258

Construction Quality:	Not Specified					Quantity RoundingRound Qty? NO Allow sum by floor or building? NO Demand Location (floor above?) No
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	SF 100					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	3					
Damage State:	DS1		DS2		DS3	
Type of Damage State:	Sequential		Sequential		Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)					
Descriptions	A few flexural and shear cracks with hardly noticeable residual crack widths. Slight yielding of extreme vertical reinforcement. No spalling. No fracture or buckling of vertical reinforcement. No structurally significant damage.		Numerous flexural and diagonal cracks with residual crack widths less than 1/64 in. Mild toe crushing with vertical cracks or light spalling at wall toes. No fracture or buckling of reinforcement. Small residual deformation.		Severe flexural cracks with residual crack widths greater than 1/32 in. Severe toe crushing and spalling. Fracture or buckling of vertical reinforcement. Significant residual deformation.	

Illustrations					
	none	B1051.003-DS2-1.JPG	B1051.003-DS3-1.JPG		
	1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, δ :	0.0018	0.0051	0.0086		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	0.73	0.65	0.56		
Total Dispersion, β :	0.73	0.65	0.56		
Correlation (Yes / No)	NO	Data Quality Not Rated	Documentation Quality Average		
Directionality (Yes / No)	YES	Data Relevance Marginal	Rationality Superior		

Consequence Functions	
Repair Description	Cosmetic repair. Patch cracks and paint each side. Remove loose masonry. Patch spalls with non-shrink grout. Grout wall. Epoxy injection. Paint each side. Shore. - Demolish existing wall. - Construct new wall.

Long Lead Time (Yes / No)	NO			NO			NO											
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.67E+02	6.00E+02	9.33E+02	3.80E+03	4.35E+03	4.93E+03	5.78E+03	7.63E+03	8.38E+03									
Best fit mean:	5.91E+02			4.36E+03			7.27E+03											
Best Fit Distribution:	LogNormal			Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	2.00	30.00		2.00	30.00		2.00	30.00										
Average Repair Cost (Min Qty, Max Qty)	7.20E+02	4.80E+02		5.22E+03	3.48E+03		9.16E+03	6.11E+03										
CV or beta (Min Qty, Max Qty)	0.36	0.36		0.10	0.10		0.14	0.14										
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.90E-01	4.70E-01	7.30E-01	2.96E+00	3.39E+00	3.85E+00	4.51E+00	5.95E+00	6.53E+00									
Best fit mean:	4.70E-01			3.39E+00			5.95E+00											
Best Fit Distribution:	LogNormal			Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	2.00	30.00		2.00	30.00		2.00	30.00										
Average Repair Time (Min Qty, Max Qty)	5.64E-01	3.76E-01		4.07E+00	2.71E+00		7.14E+00	4.76E+00										
CV or beta (Min Qty, Max Qty)	0.44	0.44		0.27	0.27		0.29	0.29										
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.2E+02	LogNormal	0.44	5.6E+02	Normal	0.27	3.1E+03	Normal	0.29									
Embodied Energy (MJ)	2.8E+03	LogNormal	0.44	1.3E+04	Normal	0.27	4.6E+04	Normal	0.29									
LifeSafety Hazard:																		
Potential non-collapse casualties? (Yes / No)	NO			NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		25%	0.50										

Comments:	None	Root Cost Multiplier:	100
Date Created:	Not Given	Date Generated:	02/26/19
Approved (YES / NO)?	By User		
Official (YES / NO) ?	By User		
Author:	Benson Shing		
Revisions:	None		

FEMA P-58 Fragility Specification

NISTIR Classification

B1051.014

NISTIR Name

Ordinary reinforced masonry walls with partially grouted cells, 8" to 12" thick, flexure dominated greater than 12' tall

Description

Costing for each 225 ft*2 Wall Panel

Line 259

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

SF 225

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	No	NO

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

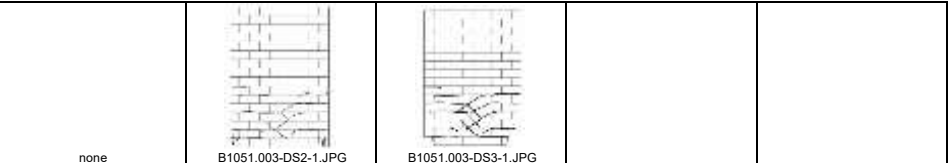
Descriptions

A few flexural and shear cracks with hardly noticeable residual crack widths. Slight yielding of extreme vertical reinforcement. No spalling. No fracture or buckling of vertical reinforcement. No structurally significant damage.

Numerous flexural and diagonal cracks with residual crack widths less than 1/64 in. Mild toe crushing with vertical cracks or light spalling at wall toes. No fracture or buckling of reinforcement. Small residual deformation.

Severe flexural cracks with residual crack widths greater than 1/32 in. Severe toe crushing and spalling. Fracture or buckling of vertical reinforcement. Significant residual deformation.

Illustrations



Damage State Probability:

none

1.00

1.00

Fragility Parameters

Median Demand, δ :

0.0018

0.0051

0.0086

Data dispersion, β_d :

Not Specified

Not Specified

Not Specified

Uncertainty, β_u :

0.73

0.65

0.56

Total Dispersion, β :

0.73

0.65

0.56

Correlation (Yes / No)

NO

Data Quality Not Rated

Documentation Quality Average

Directionality (Yes / No)

YES

Data Relevance Marginal

Rationality Superior

Consequence Functions

Repair Description

Cosmetic repair. Patch cracks and paint each side.
Remove loose masonry. Patch spalls with non-shrink grout. Grout wall. Epoxy injection. Paint each side.
Shore. - Demolish existing wall. - Construct new wall.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	8.25E+02	1.35E+03	2.10E+03	7.71E+03	8.54E+03	9.41E+03	1.19E+04	1.58E+04	1.67E+04						
Best fit mean:	1.33E+03 LogNormal			8.53E+03 LogNormal			1.48E+04 Normal								
Best Fit Distribution:	1.00			1.00			1.00								
Quantity Plateau (Min Qty, Max Qty)	1.00			1.00			1.00								
Average Repair Cost (Min Qty, Max Qty)	1.62E+03			1.02E+04			1.90E+04			1.26E+04					
CV or beta (Min Qty, Max Qty)	0.36			0.08			0.13			0.13					
Quantity Unit:	225 ft*2 Units			225 ft*2 Units			225 ft*2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	6.98E-01	1.15E+00	1.80E+00	6.57E+00	7.29E+00	8.03E+00	1.01E+01	1.35E+01	1.42E+01						
Best fit mean:	1.15E+00 LogNormal			7.29E+00 LogNormal			1.35E+01 Normal								
Best Fit Distribution:	1.00			1.00			1.00								
Quantity Plateau (Min Qty, Max Qty)	1.00			1.00			1.00								
Average Repair Time (Min Qty, Max Qty)	1.38E+00			8.75E+00			1.62E+01			1.08E+01					
CV or beta (Min Qty, Max Qty)	0.44			0.26			0.28			0.28					
Quantity Unit:	225 ft*2 Units			225 ft*2 Units			225 ft*2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.7E+02	LogNormal	0.44	1.2E+03	LogNormal	0.26	7.0E+03	Normal	0.28						
Embodied Energy (MJ)	6.3E+03	LogNormal	0.44	2.9E+04	LogNormal	0.26	1.0E+05	Normal	0.28						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		25%	0.50							

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Benson Shing

Revisions:

None

Root Cost Multiplier: 225

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

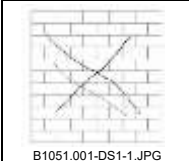
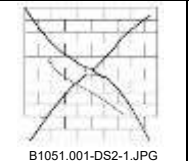
NISTIR ClassificationB1051.021

NISTIR NameOrdinary reinforced masonry walls with partially grouted cells, shear dominated, 16" thick, up to 12 foot tall

DescriptionCosting for each 100 ft^2 Wall Panel

Line 260

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	SF 100				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	2				
Damage State:	DS1	DS2			
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	First occurrence of major diagonal cracks. Cracks remain closed with hardly noticeable residual crack widths after load removal.		Wide diagonal cracks with typically one or more cracks in each direction. Crushing or spalling at wall toes.		

Illustrations				
				
Damage State Probability:	1.00			
Fragility Parameters				
Median Demand, θ :	0.002	0.0033		
Data dispersion, β_d :	Not Specified	Not Specified		
Uncertainty, β_u :	0.86	0.77		
Total Dispersion, β :	0.86	0.77		
Correlation (Yes / No)	NO		Data Quality Not Rated	Documentation Quality Average
Directionality (Yes / No)	YES		Data Relevance Marginal	Rationality Superior
Consequence Functions				
Repair Description	Grout wall. Epoxy injection. Paint each side. Shore. Demolish existing wall. Construct new wall.			

Long Lead Time (Yes / No)	NO			NO											
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.95E+03	4.50E+03	5.08E+03	6.62E+03	8.47E+03	9.22E+03									
Best fit mean:	4.51E+03			8.10E+03											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	2.00 30.00			2.00 30.00											
Average Repair Cost (Min Qty, Max Qty)	5.85E+03 3.15E+03			1.02E+04 6.35E+03											
CV or beta (Min Qty, Max Qty)	0.10 0.10			0.13 0.13											
Quantity Unit:	100 ft^2 Units			100 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	3.08E+00	3.51E+00	3.96E+00	5.16E+00	6.60E+00	7.18E+00									
Best fit mean:	3.51E+00			6.60E+00											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	2.00 30.00			2.00 30.00											
Average Repair Time (Min Qty, Max Qty)	4.56E+00 2.46E+00			7.92E+00 4.95E+00											
CV or beta (Min Qty, Max Qty)	0.27 0.27			0.28 0.28											
Quantity Unit:	100 ft^2 Units			100 ft^2 Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.2E+02	Normal	0.27	3.9E+03	Normal	0.28									
Embodied Energy (MJ)	1.5E+04	Normal	0.27	5.6E+04	Normal	0.28									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			25% 0.50											

Comments:None

Date Created:Not Given

Approved (YES / NO)?By User

Official (YES / NO) ?By User

Author:Benson Shing

Revisions:None

Root Cost Multiplier:100

Date Generated:02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1051.022

NISTIR Name
Description

Ordinary reinforced masonry walls with partially grouted cells, shear dominated,16''' thick, greater than 12 foot tall
Costing for each 225 ft*2 Wall Panel

Line 261

Construction Quality: Not Specified
Seismic Installation Conditions: Not Specified

Fragility Unit of Measure: SF 225
Demand Parameter (unit): Story Drift Ratio Unit less
Number of Damage States: 2

Quantity Rounding Round Qty? NO
Allow sum by floor or building? NO
Demand Location (floor above?) No

Damage State:	DS1	DS2			
Type of Damage State:	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	First occurrence of major diagonal cracks. Cracks remain closed with hardly noticeable residual crack widths after load removal.				
	Wide diagonal cracks with typically one or more cracks in each direction. Crushing or spalling at wall toes.				

Illustrations



Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, δ :	0.002	0.0033			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	0.86	0.77			
Total Dispersion, β :	0.86	0.77			
Correlation (Yes / No)	NO	Data Quality Not Rated		Documentation Quality Average	
Directionality (Yes / No)	YES	Data Relevance Marginal		Rationality Superior	

Consequence Functions
Repair Description

Grout wall. Epoxy injection. Paint each side. Shore. Demolish existing wall. Construct new wall.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	7.80E+03	8.63E+03	9.50E+03	1.35E+04	1.74E+04	1.83E+04									
Best fit mean:	8.61E+03			1.64E+04											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	1.00 14.00			1.00 14.00											
Average Repair Cost (Min Qty, Max Qty)	1.12E+04 6.04E+03			2.09E+04 1.31E+04											
CV or beta (Min Qty, Max Qty)	0.08 0.08			0.11 0.11											
Quantity Unit:	225 ft*2 Units			225 ft*2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	6.66E+00	7.36E+00	8.10E+00	1.15E+01	1.49E+01	1.56E+01									
Best fit mean:	7.36E+00			1.49E+01											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	1.00 14.00			1.00 14.00											
Average Repair Time (Min Qty, Max Qty)	9.56E+00 5.15E+00			1.78E+01 1.12E+01											
CV or beta (Min Qty, Max Qty)	0.26 0.26			0.27 0.27											
Quantity Unit:	225 ft*2 Units			225 ft*2 Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.4E+03	LogNormal	0.26	8.6E+03	Normal	0.27									
Embodied Energy (MJ)	3.2E+04	LogNormal	0.26	1.3E+05	Normal	0.27									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			25% 0.50											

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Benson Shing
Revisions: None

Root Cost Multiplier: 225
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR ClassificationB1051.023

NISTIR NameOrdinary reinforced masonry walls with partially grouted cells, 16" thick, flexure dominated up to 12' tall

DescriptionCosting for each 100 ft*2 Wall Panel

Line 262

Construction Quality:	Not Specified					<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	SF 100					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	3					
Damage State:	DS1		DS2		DS3	
Type of Damage State:	Sequential		Sequential		Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)					
Descriptions	A few flexural and shear cracks with hardly noticeable residual crack widths. Slight yielding of extreme vertical reinforcement. No spalling. No fracture or buckling of vertical reinforcement. No structurally significant damage.		Numerous flexural and diagonal cracks with residual crack widths less than 1/64 in. Mild toe crushing with vertical cracks or light spalling at wall toes. No fracture or buckling of reinforcement. Small residual deformation.		Severe flexural cracks with residual crack widths greater than 1/32 in. Severe toe crushing and spalling. Fracture or buckling of vertical reinforcement. Significant residual deformation.	

Illustrations					
	none	B1051.003-DS2-1.JPG	B1051.003-DS3-1.JPG		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, δ :	0.0018	0.0051	0.0086		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	0.73	0.65	0.56		
Total Dispersion, β :	0.73	0.65	0.56		

Correlation (Yes / No)NO

Directionality (Yes / No)YES

Data QualityNot Rated

Data RelevanceMarginal

Documentation QualityAverage

RationalitySuperior

Consequence Functions

Repair DescriptionCosmetic repair. Patch cracks and paint each side.
Remove loose masonry. Patch spalls with non-shrink grout. Grout wall. Epoxy injection. Paint each side.
Shore. - Demolish existing wall. - Construct new wall.

Long Lead Time (Yes / No)NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.67E+02	6.00E+02	9.33E+02	3.95E+03	4.50E+03	5.08E+03	6.62E+03	8.47E+03	9.22E+03						
Best fit mean:	5.91E+02			4.51E+03			8.10E+03								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	2.00 30.00			2.00 30.00			2.00 30.00								
Average Repair Cost (Min Qty, Max Qty)	7.80E+02 4.20E+02			5.40E+03 3.38E+03			1.02E+04 6.35E+03								
CV or beta (Min Qty, Max Qty)	0.36 0.36			0.10 0.10			0.13 0.13								
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.90E-01	4.70E-01	7.30E-01	3.08E+00	3.51E+00	3.96E+00	5.16E+00	6.60E+00	7.18E+00						
Best fit mean:	4.70E-01			3.51E+00			6.60E+00								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	2.00 30.00			2.00 30.00			2.00 30.00								
Average Repair Time (Min Qty, Max Qty)	6.10E-01 3.30E-01			4.21E+00 2.63E+00			7.92E+00 4.95E+00								
CV or beta (Min Qty, Max Qty)	0.44 0.44			0.27 0.27			0.28 0.28								
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.2E+02	LogNormal	0.44	6.2E+02	Normal	0.27	3.9E+03	Normal	0.28						
Embodied Energy (MJ)	2.8E+03	LogNormal	0.44	1.5E+04	Normal	0.27	5.6E+04	Normal	0.28						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		25%	0.50							

Comments:None

Date Created:Not Given

Approved (YES / NO)?By User

Official (YES / NO) ?By User

Author:Benson Shing

Revisions:None

Root Cost Multiplier: 100

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1051.024

NISTIR Name

Ordinary reinforced masonry walls with partially grouted cells, 16" thick, flexure dominated greater than 12' tall

Description

Costing for each 225 ft^2 Wall Panel

Line 263

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

SF 225

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	No	NO

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

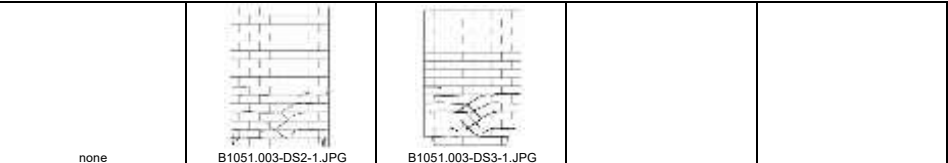
Descriptions

A few flexural and shear cracks with hardly noticeable residual crack widths. Slight yielding of extreme vertical reinforcement. No spalling. No fracture or buckling of vertical reinforcement. No structurally significant damage.

Numerous flexural and diagonal cracks with residual crack widths less than 1/64 in. Mild toe crushing with vertical cracks or light spalling at wall toes. No fracture or buckling of reinforcement. Small residual deformation.

Severe flexural cracks with residual crack widths greater than 1/32 in. Severe toe crushing and spalling. Fracture or buckling of vertical reinforcement. Significant residual deformation.

Illustrations



Damage State Probability:

none

1.00

1.00

Fragility Parameters

Median Demand, δ :

0.0018

0.0051

0.0086

Data dispersion, β_d :

Not Specified

Not Specified

Not Specified

Uncertainty, β_u :

0.73

0.65

0.56

Total Dispersion, β :

0.73

0.65

0.56

Correlation (Yes / No)

NO

Data Quality Not Rated

Documentation Quality Average

Directionality (Yes / No)

YES

Data Relevance Marginal

Rationality Superior

Consequence Functions

Repair Description

Cosmetic repair. Patch cracks and paint each side.
Remove loose masonry. Patch spalls with non-shrink grout. Grout wall. Epoxy injection. Paint each side.
Shore. - Demolish existing wall. - Construct new wall.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	8.25E+02	1.35E+03	2.10E+03	7.80E+03	8.63E+03	9.50E+03	1.35E+04	1.74E+04	1.83E+04						
Best fit mean:	1.33E+03 LogNormal			8.61E+03 LogNormal			1.64E+04 Normal								
Best Fit Distribution:	1.00			1.00			1.00								
Quantity Plateau (Min Qty, Max Qty)	14.00			14.00			14.00								
Average Repair Cost (Min Qty, Max Qty)	1.76E+03			1.04E+04			2.09E+04			1.31E+04					
CV or beta (Min Qty, Max Qty)	0.36			0.08			0.11			0.11					
Quantity Unit:	225 ft^2 Units			225 ft^2 Units			225 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	6.98E-01	1.15E+00	1.80E+00	6.66E+00	7.36E+00	8.10E+00	1.15E+01	1.49E+01	1.56E+01						
Best fit mean:	1.15E+00 LogNormal			7.36E+00 LogNormal			1.49E+01 Normal								
Best Fit Distribution:	1.00			1.00			1.00								
Quantity Plateau (Min Qty, Max Qty)	14.00			14.00			14.00								
Average Repair Time (Min Qty, Max Qty)	1.49E+00			8.83E+00			1.78E+01			1.12E+01					
CV or beta (Min Qty, Max Qty)	0.44			0.26			0.27			0.27					
Quantity Unit:	225 ft^2 Units			225 ft^2 Units			225 ft^2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.7E+02	LogNormal	0.44	1.4E+03	LogNormal	0.26	8.6E+03	Normal	0.27						
Embodied Energy (MJ)	6.3E+03	LogNormal	0.44	3.2E+04	LogNormal	0.26	1.3E+05	Normal	0.27						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%			0%			0%			0%					
Loss of Life (Median, Dispersion)	0%			0%			0%			0%					
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%			0%			25%			0.50					

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Benson Shing

Revisions:

None

Root Cost Multiplier: 225

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification B1052.001

NISTIR Name Description Special reinforced masonry walls with fully grouted cells, 8" or 12" thick, shear dominated, up to 12' tall

Costing for each 100 ft^2 Wall Panel

Line 264

Construction Quality:	Not Specified					<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	SF 100					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	First occurrence of major diagonal cracks. Cracks remain closed with hardly noticeable residual crack widths after load removal.		Wide diagonal cracks with typically one or more cracks in each direction. Crushing or spalling at wall toes.			

Illustrations



Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, δ :	0.0036	0.0059			
Data dispersion, β_d :	0.54	0.44			
Uncertainty, β_u :	0.24	0.26			
Total Dispersion, β :	0.59	0.51			
Correlation (Yes / No)	NO	Data Quality Not Rated	Documentation Quality Average		
Directionality (Yes / No)	YES	Data Relevance Marginal	Rationality Superior		

Consequence Functions

Repair Description

Epoxy injection. Paint each side.

Shore. Demolish existing wall. Construct new wall.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.40E+03	3.95E+03	4.53E+03	5.98E+03	7.83E+03	8.42E+03									
Best fit mean:	3.96E+03			7.41E+03											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	2.00 30.00			2.00 30.00											
Average Repair Cost (Min Qty, Max Qty)	5.14E+03 0.11			9.40E+03 0.13											
CV or beta (Min Qty, Max Qty)	0.11 0.11			0.13 0.13											
Quantity Unit:	100 ft^2 Units			100 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.65E+00	3.08E+00	3.53E+00	4.66E+00	6.11E+00	6.56E+00									
Best fit mean:	3.08E+00			6.11E+00											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	2.00 30.00			2.00 30.00											
Average Repair Time (Min Qty, Max Qty)	4.00E+00 0.27			7.33E+00 0.28											
CV or beta (Min Qty, Max Qty)	0.27 0.27			0.28 0.28											
Quantity Unit:	100 ft^2 Units			100 ft^2 Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.6E+02	Normal	0.27	3.4E+03	Normal	0.28									
Embodied Energy (MJ)	1.1E+04	Normal	0.27	5.0E+04	Normal	0.28									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			25% 0.50											

Comments: None

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Benson Shing

Revisions: None

Root Cost Multiplier: 100

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1052.002

NISTIR Name
Description

Special reinforced masonry walls with fully grouted cells, 8" or 12" thick, shear dominated, greater than 12' tall
Costing for each 225 ft^2 Wall Panel

Line 265

Construction Quality:	Not Specified				Quantity Rounding Round Qty? NO Allow sum by floor or building? NO Demand Location (floor above)? No
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	SF 225				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	2				
Damage State:	DS1		DS2		
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	First occurrence of major diagonal cracks. Cracks remain closed with hardly noticeable residual crack widths after load removal.		Wide diagonal cracks with typically one or more cracks in each direction. Crushing or spalling at wall toes.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Illustrations



Damage State Probability:		1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0036	0.0059			
Data dispersion, β_d :	0.54	0.44			
Uncertainty, β_u :	0.24	0.26			
Total Dispersion, β :	0.59	0.51			
Correlation (Yes / No)	NO	Data Quality Not Rated		Documentation Quality	Average
Directionality (Yes / No)	YES	Data Relevance Marginal		Rationality	Superior

Consequence Functions
Repair Description

Epoxy injection. Paint each side.
Shore. Demolish existing wall. Construct new wall.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	6.81E+03	7.64E+03	8.51E+03	1.24E+04	1.63E+04	1.71E+04									
Best fit mean:	7.62E+03			1.52E+04											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	1.00 14.00			1.00 14.00											
Average Repair Cost (Min Qty, Max Qty)	9.93E+03 5.35E+03			1.95E+04 1.22E+04											
CV or beta (Min Qty, Max Qty)	0.09 0.09			0.12 0.12											
Quantity Unit:	225 ft^2 Units			225 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.81E+00	6.53E+00	7.27E+00	1.05E+01	1.39E+01	1.46E+01									
Best fit mean:	6.53E+00			1.39E+01											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	1.00 14.00			1.00 14.00											
Average Repair Time (Min Qty, Max Qty)	8.48E+00 4.57E+00			1.66E+01 1.04E+01											
CV or beta (Min Qty, Max Qty)	0.26 0.26			0.28 0.28											
Quantity Unit:	225 ft^2 Units			225 ft^2 Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	9.9E+02	LogNormal	0.26	7.6E+03	Normal	0.28									
Embodied Energy (MJ)	2.3E+04	LogNormal	0.26	1.1E+05	Normal	0.28									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			25% 0.50											

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Benson Shing
Revisions: None

Root Cost Multiplier: 225
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR ClassificationB1052.003

NISTIR NameDescription

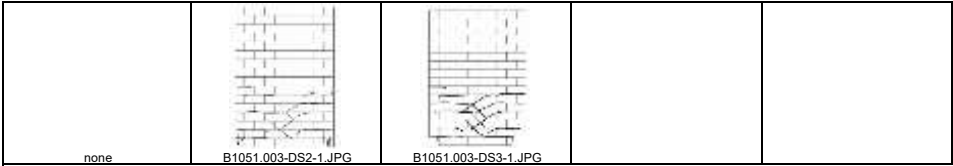
Special reinforced masonry walls with fully grouted cells, 8" to 12" thick, flexure dominated up to 12' tall

Costing for each 100 ft*2 Wall Panel

Line 266

Construction Quality:	Not Specified					<div>Quantity RoundingRound Qty?NO</div> <div>Allow sum by floor or building?NO</div> <div>Demand Location (floor above?)No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	SF 100					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	3					
Damage State:	DS1		DS2		DS3	
Type of Damage State:	Sequential		Sequential		Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)					
Descriptions	A few flexural and shear cracks with hardly noticeable residual crack widths. Slight yielding of extreme vertical reinforcement. No spalling. No fracture or buckling of vertical reinforcement. No structurally significant damage.		Numerous flexural and diagonal cracks with residual crack widths less than 1/64 in. Mild toe crushing with vertical cracks or light spalling at wall toes. No fracture or buckling of reinforcement. Small residual deformation.		Severe flexural cracks with residual crack widths greater than 1/32 in. Severe toe crushing and spalling. Fracture or buckling of vertical reinforcement. Significant residual deformation.	

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, δ :	0.0031	0.009	0.0151		
Data dispersion, β_d :	0.4	0.27	0.2		
Uncertainty, β_u :	0.25	0.25	0.25		
Total Dispersion, β :	0.47	0.4	0.32		
Correlation (Yes / No)	NO	Data Quality Not Rated	Documentation Quality Average		
Directionality (Yes / No)	YES	Data Relevance Marginal	Rationality Superior		

Consequence Functions			
Repair Description	Cosmetic repair. Patch cracks and paint each side.	Epoxy injection to repair cracks. Remove loose masonry. Patch spalls with non-shrink grout. Paint each side.	Shore. - Demolish existing wall. - Construct new wall.

Long Lead Time (Yes / No)NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.67E+02	6.00E+02	9.33E+02	3.40E+03	3.95E+03	4.53E+03	5.98E+03	7.83E+03	8.42E+03						
Best fit mean:	5.91E+02			3.96E+03			7.41E+03								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	2.00		30.00	2.00		30.00	2.00		30.00						
Average Repair Cost (Min Qty, Max Qty)	9.00E+02		4.80E+02	5.93E+03		3.36E+03	1.18E+04		6.66E+03						
CV or beta (Min Qty, Max Qty)	0.36		0.36	0.11		0.11	0.13		0.13						
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.90E-01	4.70E-01	7.30E-01	2.65E+00	3.08E+00	3.53E+00	4.66E+00	6.11E+00	6.56E+00						
Best fit mean:	4.70E-01			3.08E+00			6.11E+00								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	2.00		30.00	2.00		30.00	2.00		30.00						
Average Repair Time (Min Qty, Max Qty)	7.04E-01		3.76E-01	4.62E+00		2.62E+00	9.16E+00		5.19E+00						
CV or beta (Min Qty, Max Qty)	0.44		0.44	0.27		0.27	0.28		0.28						
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.2E+02	LogNormal	0.44	4.6E+02	Normal	0.27	3.4E+03	Normal	0.28						
Embodied Energy (MJ)	2.8E+03	LogNormal	0.44	1.1E+04	Normal	0.27	5.0E+04	Normal	0.28						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		25%	0.50							

Comments:None

Date Created:Not Given

Approved (YES / NO)?By User

Official (YES / NO) ?By User

Author:Benson Shing

Revisions:None

Root Cost Multiplier:100

Date Generated:02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1052.004

NISTIR Name
Description

Special reinforced masonry walls with fully grouted cells, 8" to 12" thick, flexure dominated greater than 12' tall
Costing for each 225 ft*2 Wall Panel

Line 267

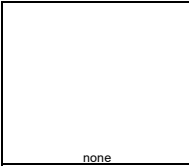

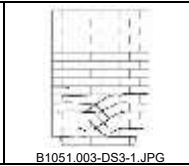
Construction Quality: Not Specified
Seismic Installation Conditions: Not Specified

Fragility Unit of Measure:	SF 225
Demand Parameter (unit):	Story Drift Ratio
Number of Damage States:	3

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	A few flexural and shear cracks with hardly noticeable residual crack widths. Slight yielding of extreme vertical reinforcement. No spalling. No fracture or buckling of vertical reinforcement. No structurally significant damage.	Numerous flexural and diagonal cracks with residual crack widths less than 1/64 in. Mild toe crushing with vertical cracks or light spalling at wall toes. No fracture or buckling of reinforcement. Small residual deformation.	Severe flexural cracks with residual crack widths greater than 1/32 in. Severe toe crushing and spalling. Fracture or buckling of vertical reinforcement. Significant residual deformation.		

Illustrations

				
none	B1051.003-DS2-1.JPG	B1051.003-DS3-1.JPG		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, δ :	0.0031	0.009	0.0151		
Data dispersion, β_d :	0.4	0.27	0.2		
Uncertainty, β_u :	0.25	0.25	0.25		
Total Dispersion, β :	0.47	0.4	0.32		

Correlation (Yes / No)	NO	Data Quality	Not Rated	Documentation Quality	Average
Directionality (Yes / No)	YES	Data Relevance	Marginal	Rationality	Superior

Consequence Functions

Repair Description

Cosmetic repair. Patch cracks and paint each side.
Epoxy injection to repair cracks. Remove loose masonry. Patch spalls with non-shrink grout. Paint each side.
Shore. - Demolish existing wall. - Construct new wall.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	8.25E+02	1.35E+03	2.10E+03	6.81E+03	7.64E+03	8.51E+03	1.24E+04	1.63E+04	1.71E+04						
Best fit mean:	1.33E+03 LogNormal			7.62E+03 LogNormal			1.52E+04 Normal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	1.00 14.00			1.00 14.00			1.00 14.00								
Average Repair Cost (Min Qty, Max Qty)	2.03E+03 1.08E+03			1.15E+04 6.49E+03			2.44E+04 1.38E+04								
CV or beta (Min Qty, Max Qty)	0.36 0.36			0.09 0.09			0.12 0.12								
Quantity Unit:	225 ft*2 Units			225 ft*2 Units			225 ft*2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	6.98E-01	1.15E+00	1.80E+00	5.81E+00	6.53E+00	7.27E+00	1.05E+01	1.39E+01	1.46E+01						
Best fit mean:	1.15E+00 LogNormal			6.53E+00 LogNormal			1.39E+01 Normal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	1.00 14.00			1.00 14.00			1.00 14.00								
Average Repair Time (Min Qty, Max Qty)	1.72E+00 9.17E-01			9.78E+00 5.55E+00			2.08E+01 1.18E+01								
CV or beta (Min Qty, Max Qty)	0.44 0.44			0.26 0.26			0.28 0.28								
Quantity Unit:	225 ft*2 Units			225 ft*2 Units			225 ft*2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.7E+02	LogNormal	0.44	9.9E+02	LogNormal	0.26	7.6E+03	Normal	0.28						
Embodied Energy (MJ)	6.3E+03	LogNormal	0.44	2.3E+04	LogNormal	0.26	1.1E+05	Normal	0.28						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			25% 0.50								

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Benson Shing
Revisions: None

Root Cost Multiplier: 225
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification B1052.011

NISTIR Name Special reinforced masonry walls with fully grouted cells, 16" thick, shear dominated, up to 12" tall

Description Costing for each 100 ft^2 Wall Panel

Line 268

Construction Quality:	Not Specified				Quantity Rounding Round Qty? NO Allow sum by floor or building? NO Demand Location (floor above?) No
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	SF 100				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	2				
Damage State:	DS1		DS2		
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	First occurrence of major diagonal cracks. Cracks remain closed with hardly noticeable residual crack widths after load removal.		Wide diagonal cracks with typically one or more cracks in each direction. Crushing or spalling at wall toes.		

Illustrations



Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, δ :	0.0036	0.0059			
Data dispersion, β_d :	0.54	0.44			
Uncertainty, β_u :	0.24	0.26			
Total Dispersion, β :	0.59	0.51			
Correlation (Yes / No)	NO		Data Quality Not Rated	Documentation Quality Average	
Directionality (Yes / No)	YES		Data Relevance Marginal	Rationality Superior	

Consequence Functions

Repair Description

Epoxy injection at cracks. Paint each side.

Shore. Demolish existing wall. Construct new wall.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.55E+03	4.10E+03	4.68E+03	6.92E+03	8.77E+03	9.35E+03									
Best fit mean:	4.11E+03			8.34E+03											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	2.00 30.00			2.00 30.00											
Average Repair Cost (Min Qty, Max Qty)	6.15E+03 3.28E+03			1.32E+04 7.45E+03											
CV or beta (Min Qty, Max Qty)	0.11 0.11			0.11 0.11											
Quantity Unit:	100 ft^2 Units			100 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.77E+00	3.20E+00	3.65E+00	5.39E+00	6.83E+00	7.29E+00									
Best fit mean:	3.20E+00			6.83E+00											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	2.00 30.00			2.00 30.00											
Average Repair Time (Min Qty, Max Qty)	4.80E+00 2.56E+00			1.02E+01 5.81E+00											
CV or beta (Min Qty, Max Qty)	0.27 0.27			0.27 0.27											
Quantity Unit:	100 ft^2 Units			100 ft^2 Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	5.2E+02	Normal	0.27	4.3E+03	Normal	0.27									
Embodied Energy (MJ)	1.2E+04	Normal	0.27	6.3E+04	Normal	0.27									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			25% 0.50											

Comments: None

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Benson Shing

Revisions: None

Root Cost Multiplier: 100

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR ClassificationB1052.012

NISTIR NameDescription

Special reinforced masonry walls with fully grouted cells, 16" thick, shear dominated, greater than 12' tall

Costing for each 225 ft^2 Wall Panel

Line 269

Construction Quality:	Not Specified					Quantity Rounding		Round Qty?	NO
Seismic Installation Conditions:	Not Specified					Allow sum by floor or building?		NO	
Fragility Unit of Measure:	SF 225					Demand Location (floor above?)		No	
Demand Parameter (unit):	Story Drift Ratio					Unit less			
Number of Damage States:	2								
Damage State:	DS1		DS2						
Type of Damage State:	Sequential		Sequential						
DS Hierarchy	Seq(DS1,DS2)								
Descriptions	First occurrence of major diagonal cracks. Cracks remain closed with hardly noticeable residual crack widths after load removal.		Wide diagonal cracks with typically one or more cracks in each direction. Crushing or spalling at wall toes.						

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Illustrations



Damage State Probability:		1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0036	0.0059			
Data dispersion, β_d :	0.54	0.44			
Uncertainty, β_u :	0.24	0.26			
Total Dispersion, β :	0.59	0.51			
Correlation (Yes / No)	NO	Data Quality Not Rated		Documentation Quality	Average
Directionality (Yes / No)	YES	Data Relevance Marginal		Rationality	Superior

Consequence Functions
Repair Description

Epoxy injection at cracks. Paint each side. Shore. Demolish existing wall. Construct new wall.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	7.15E+03	7.98E+03	8.85E+03	1.42E+04	1.81E+04	1.90E+04									
Best fit mean:	7.96E+03			1.71E+04											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	1.00	14.00		1.00	14.00										
Average Repair Cost (Min Qty, Max Qty)	1.20E+04		6.38E+03	2.72E+04		1.54E+04									
CV or beta (Min Qty, Max Qty)	0.08		0.08	0.11		0.11									
Quantity Unit:	225 ft² Units			225 ft² Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	6.10E+00	6.80E+00	7.54E+00	1.21E+01	1.54E+01	1.62E+01									
Best fit mean:	6.80E+00			1.54E+01											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	1.00	14.00		1.00	14.00										
Average Repair Time (Min Qty, Max Qty)	1.02E+01		5.43E+00	2.32E+01		1.31E+01									
CV or beta (Min Qty, Max Qty)	0.26		0.26	0.27		0.27									
Quantity Unit:	225 ft² Units			225 ft² Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.1E+03	LogNormal	0.26	9.6E+03	Normal	0.27									
Embodied Energy (MJ)	2.6E+04	LogNormal	0.26	1.4E+05	Normal	0.27									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO					YES									
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			25% 0.50											

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Benson Shing

None

Root Cost Multiplier: 225

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification B1052.013

NISTIR Name Description

Special reinforced masonry walls with fully grouted cells, 16" thick, flexure dominated up to 12' tall

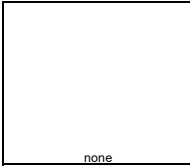

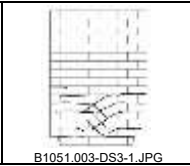
Costing for each 100 ft*2 Wall Panel

Line 270

Construction Quality:	Not Specified			
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	SF 100			
Demand Parameter (unit):	Story Drift Ratio Unit less			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	A few flexural and shear cracks with hardly noticeable residual crack widths. Slight yielding of extreme vertical reinforcement. No spalling. No fracture or buckling of vertical reinforcement. No structurally significant damage.	Numerous flexural and diagonal cracks with residual crack widths less than 1/64 in. Mild toe crushing with vertical cracks or light spalling at wall toes. No fracture or buckling of reinforcement. Small residual deformation.	Severe flexural cracks with residual crack widths greater than 1/32 in. Severe toe crushing and spalling. Fracture or buckling of vertical reinforcement. Significant residual deformation.	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Illustrations

				
none	B1051.003-DS2-1.JPG	B1051.003-DS3-1.JPG		
1.00	1.00	1.00		

Damage State Probability:				
Fragility Parameters				
Median Demand, δ :	0.0031	0.009	0.0151	
Data dispersion, β_d :	0.4	0.27	0.2	
Uncertainty, β_u :	0.25	0.25	0.25	
Total Dispersion, β :	0.47	0.4	0.32	

Correlation (Yes / No)	NO	Data Quality	Not Rated	Documentation Quality	Average
Directionality (Yes / No)	YES	Data Relevance	Marginal	Rationality	Superior

Consequence Functions

Repair Description	Cosmetic repair. Patch cracks and paint each side.	Epoxy injection to repair cracks. Remove loose masonry. Patch spalls with non-shrink grout. Paint each side.	Shore. - Demolish existing wall. - Construct new wall.
--------------------	--	--	--

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.67E+02	6.00E+02	9.33E+02	3.55E+03	4.10E+03	4.68E+03	6.92E+03	8.77E+03	9.35E+03						
Best fit mean:	5.91E+02			4.11E+03			8.34E+03								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	2.00 30.00			2.00 30.00			2.00 30.00								
Average Repair Cost (Min Qty, Max Qty)	9.00E+02 4.80E+02			6.15E+03 3.49E+03			1.32E+04 7.45E+03								
CV or beta (Min Qty, Max Qty)	0.36 0.36			0.11 0.11			0.11 0.11								
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.90E-01	4.70E-01	7.30E-01	2.77E+00	3.20E+00	3.65E+00	5.39E+00	6.83E+00	7.29E+00						
Best fit mean:	4.70E-01			3.20E+00			6.83E+00								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	2.00 30.00			2.00 30.00			2.00 30.00								
Average Repair Time (Min Qty, Max Qty)	7.04E-01 3.76E-01			4.80E+00 2.72E+00			1.02E+01 5.81E+00								
CV or beta (Min Qty, Max Qty)	0.44 0.44			0.27 0.27			0.27 0.27								
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.2E+02	LogNormal	0.44	5.2E+02	Normal	0.27	4.3E+03	Normal	0.27						
Embodied Energy (MJ)	2.8E+03	LogNormal	0.44	1.2E+04	Normal	0.27	6.3E+04	Normal	0.27						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			25% 0.50								

Comments:	None	Root Cost Multiplier:	100
Date Created:	Not Given	Date Generated:	02/26/19
Approved (YES / NO)?	By User		
Official (YES / NO) ?	By User		
Author:	Benson Shing		
Revisions:	None		

FEMA P-58 Fragility Specification

NISTIR Classification

B1052.014

NISTIR Name

Special reinforced masonry walls with fully grouted cells, 16" thick, flexure dominated greater than 12' tall

Description

Costing for each 225 ft^2 Wall Panel

Line 271

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

SF 225

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	No	NO

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

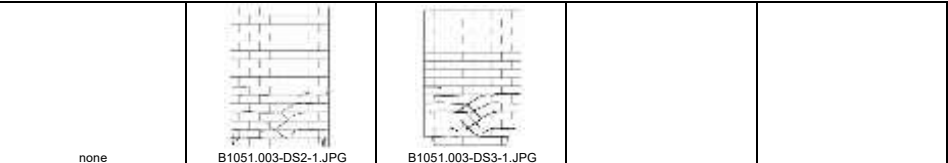
Descriptions

A few flexural and shear cracks with hardly noticeable residual crack widths. Slight yielding of extreme vertical reinforcement. No spalling. No fracture or buckling of vertical reinforcement. No structurally significant damage.

Numerous flexural and diagonal cracks with residual crack widths less than 1/64 in. Mild toe crushing with vertical cracks or light spalling at wall toes. No fracture or buckling of reinforcement. Small residual deformation.

Severe flexural cracks with residual crack widths greater than 1/32 in. Severe toe crushing and spalling. Fracture or buckling of vertical reinforcement. Significant residual deformation.

Illustrations



Damage State Probability:

none

1.00

1.00

1.00

Fragility Parameters

Median Demand, δ :

0.0031

0.009

0.0151

Data dispersion, β_d :

0.4

0.27

0.2

Uncertainty, β_u :

0.25

0.25

0.25

Total Dispersion, β :

0.47

0.4

0.32

Correlation (Yes / No)

NO

Data Quality Not Rated

Documentation Quality Average

Directionality (Yes / No)

YES

Data Relevance Marginal

Rationality Superior

Consequence Functions

Repair Description

Cosmetic repair. Patch cracks and paint each side.

Epoxy injection to repair cracks. Remove loose masonry. Patch spalls with non-shrink grout. Paint each side.

Shore. - Demolish existing wall. - Construct new wall.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	8.25E+02	1.35E+03	2.10E+03	7.15E+03	7.98E+03	8.85E+03	1.42E+04	1.81E+04	1.90E+04						
Best fit mean:	1.33E+03 LogNormal			7.96E+03 LogNormal			1.71E+04 Normal								
Best Fit Distribution:	1.00			1.00			1.00								
Quantity Plateau (Min Qty, Max Qty)	14.00			14.00			14.00								
Average Repair Cost (Min Qty, Max Qty)	2.03E+03			1.20E+04			2.72E+04			1.54E+04					
CV or beta (Min Qty, Max Qty)	0.36			0.08			0.11			0.11					
Quantity Unit:	225 ft^2 Units			225 ft^2 Units			225 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	6.98E-01	1.15E+00	1.80E+00	6.10E+00	6.80E+00	7.54E+00	1.21E+01	1.54E+01	1.62E+01						
Best fit mean:	1.15E+00 LogNormal			6.80E+00 LogNormal			1.54E+01 Normal								
Best Fit Distribution:	1.00			1.00			1.00								
Quantity Plateau (Min Qty, Max Qty)	14.00			14.00			14.00								
Average Repair Time (Min Qty, Max Qty)	1.72E+00			1.02E+01			2.32E+01			1.31E+01					
CV or beta (Min Qty, Max Qty)	0.44			0.26			0.27			0.27					
Quantity Unit:	225 ft^2 Units			225 ft^2 Units			225 ft^2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.7E+02	LogNormal	0.44	1.1E+03	LogNormal	0.26	9.6E+03	Normal	0.27						
Embodied Energy (MJ)	6.3E+03	LogNormal	0.44	2.6E+04	LogNormal	0.26	1.4E+05	Normal	0.27						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		25%	0.50							

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Benson Shing

Revisions:

None

Root Cost Multiplier: 225

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1061.001a

NISTIR Name

Cold formed steel walls with wood structural panel sheathing, interior - gypsum board

Description

Costing for each 100 ft*2 Wall Panel. Assumed framing: 38 mil cold formed steel framing with 7/16 OSB and 3/8 plywood panel sheathing with overturning restraint at each end of the wall per AISI design standard. No. 8 screws 2" to 6" OC at perimeter and 12" OC EW in field.

Construction Quality:

High quality

Seismic Installation Conditions:

Overturning restraint at each end of wall.

Fragility Unit of Measure:

SF 100

Demand Parameter (unit):

Story Drift Ratio

Unit less

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

Sheathing faster pull through or tear out. (20% of fasteners.)

Failure of structural panels.

Failure of wall.

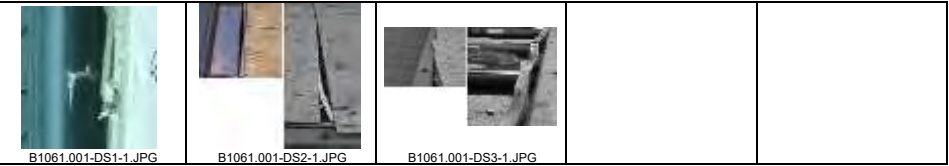
Quantity Rounding

Round Qty? NO

Allow sum by floor or building? NO

Demand Location (floor above?) No

Illustrations



Damage State Probability:

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.004

0.0226

0.0267

Data dispersion, β_d :

0.4

0.30

0.25

Uncertainty, β_u :

0.1

0.1

0.1

Total Dispersion, β :

0.4

0.3

0.25

Correlation (Yes / No)

NO

Directionality (Yes / No)

YES

Data Quality Superior

Data Relevance Superior

Documentation Quality Superior

Rationality Superior

Consequence Functions

Repair Description

Remove damaged wall, ceilings, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work. Replace 20% of fasteners, replace gypsum wall board, tape and sand, repaint.

Remove damaged wall, ceilings, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work. Replace sheathing, replace gypsum wall board, tape and sand, repaint.

Remove damaged wall, ceilings, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Provide shoring. Modify mechanical and electrical as required for repair work. Replace metal stud framing, boundary elements, sheathing, replace gypsum wall board, tape and sand, repaint.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.10E+03	3.05E+03	4.67E+03	2.00E+03	3.50E+03	5.68E+03	3.47E+03	4.50E+03	4.65E+03						
Best fit mean:	3.10E+03 LogNormal			3.43E+03 LogNormal			4.21E+03 Normal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	2.00 30.00			2.00 30.00			2.00 30.00								
Average Repair Cost (Min Qty, Max Qty)	4.58E+03 2.44E+03			5.25E+03 2.98E+03			6.75E+03 3.83E+03								
CV or beta (Min Qty, Max Qty)	0.32 0.32			0.40 0.40			0.11 0.11								
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.04E+00	2.96E+00	4.53E+00	1.94E+00	3.40E+00	5.52E+00	3.36E+00	4.37E+00	4.51E+00						
Best fit mean:	2.96E+00 LogNormal			3.40E+00 LogNormal			4.37E+00 Normal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	2.00 30.00			2.00 30.00			2.00 30.00								
Average Repair Time (Min Qty, Max Qty)	4.44E+00 2.37E+00			5.10E+00 2.89E+00			6.55E+00 3.71E+00								
CV or beta (Min Qty, Max Qty)	0.40 0.40			0.47 0.47			0.27 0.27								
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.8E+03	LogNormal	0.40	1.9E+03	LogNormal	0.47	2.5E+03	Normal	0.27						
Embodied Energy (MJ)	1.9E+04	LogNormal	0.40	2.2E+04	LogNormal	0.47	3.9E+04	Normal	0.27						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			25% 0.50			10% 0.50								

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

None

Root Cost Multiplier: 100

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1061.001b

NISTIR Name
Description

Cold formed steel walls with wood structural panel sheathing, exterior - stucco one side
Costing for each 100 ft*2 Wall Panel. Assumed framing: 38 mil cold formed steel framing with 7/16 OSB and 3/8 plywood panel sheathing with overturning restraint at each end of the wall per AISI design standard. No. 8 screws 2" to 6" OC at perimeter and 12" OC EW in field.

Line 273

Construction Quality:	High quality													
Seismic Installation Conditions:	Overturning restraint at each end of wall.													
Fragility Unit of Measure:	SF 100		<table><tr><td>Quantity Rounding</td><td>Round Qty?</td><td>NO</td></tr><tr><td>Allow sum by floor or building?</td><td>NO</td><td>NO</td></tr><tr><td>Demand Location (floor above?)</td><td>NO</td><td>NO</td></tr></table>			Quantity Rounding	Round Qty?	NO	Allow sum by floor or building?	NO	NO	Demand Location (floor above?)	NO	NO
Quantity Rounding	Round Qty?	NO												
Allow sum by floor or building?	NO	NO												
Demand Location (floor above?)	NO	NO												
Demand Parameter (unit):	Story Drift Ratio		Unit less											
Number of Damage States:	3													
Damage State:	DS1	DS2	DS3											
Type of Damage State:	Sequential	Sequential	Sequential											
DS Hierarchy	Seq(DS1,DS2,DS3)													
Descriptions	Sheathing faster pull through or tear out. (20% of fasteners.)	Failure of structural panels.	Failure of wall.											

Illustrations

				
B1061.001-DS1-1.JPG	B1061.001-DS2-1.JPG	B1061.001-DS3-1.JPG		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, δ :	0.004	0.0226	0.0267		
Data dispersion, β_d :	0.4	0.30	0.25		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.4	0.3	0.25		
Correlation (Yes / No)	NO	Data Quality Superior	Documentation Quality Superior		
Directionality (Yes / No)	YES	Data Relevance Superior	Rationality Superior		

Consequence Functions
Repair Description

Remove damaged wall, ceilings, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work. Replace 20% of fasteners, replace gypsum wall board, stucco, tape and sand, repaint.

Remove damaged wall, ceilings, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work. Replace sheathing, replace gypsum wall board, stucco, tape and sand, repaint.

Remove damaged wall, ceilings, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Provide shoring. Modify mechanical and electrical as required for repair work. Replace metal stud framing, boundary elements, sheathing, replace gypsum wall board, stucco, tape and sand, repaint.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.76E+03	2.19E+03	2.98E+03	3.41E+03	3.83E+03	6.06E+03	4.59E+03	5.38E+03	5.96E+03						
Best fit mean:	2.25E+03			4.27E+03			5.31E+03								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	2.00 30.00			2.00 30.00			2.00 30.00								
Average Repair Cost (Min Qty, Max Qty)	3.29E+03 1.75E+03			5.74E+03 3.25E+03			8.06E+03 4.57E+03								
CV or beta (Min Qty, Max Qty)	0.21 0.21			0.25 0.25			0.10 0.10								
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.71E+00	2.13E+00	2.89E+00	3.31E+00	3.71E+00	5.88E+00	4.46E+00	5.22E+00	5.78E+00						
Best fit mean:	2.13E+00			3.71E+00			5.22E+00								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	2.00 30.00			2.00 30.00			2.00 30.00								
Average Repair Time (Min Qty, Max Qty)	3.19E+00 1.70E+00			5.57E+00 3.15E+00			7.83E+00 4.44E+00								
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.35 0.35			0.27 0.27								
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.0E+03	LogNormal	0.33	2.8E+03	LogNormal	0.35	3.4E+03	Normal	0.27						
Embodied Energy (MJ)	2.1E+04	LogNormal	0.33	3.1E+04	LogNormal	0.35	4.8E+04	Normal	0.27						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			25% 0.50			10% 0.50								

Comments:	None					Root Cost Multiplier:	100
Date Created:	Not Given					Date Generated:	02/26/19
Approved (YES / NO)?	By User						
Official (YES / NO) ?	By User						
Author:	Not Given						
Revisions:	None						

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1061.011a

Cold formed steel walls with flat strap X-bracing, interior - gypsum board

Costing for each 100 ft*2 Wall Panel. Assumed framing: 33 mil cold formed steel framing with 4.5 inch x 33 mil flat strap X-bracing on one side. Straps attached to gussets with No. 8 screws.

Line 274

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

High quality

Overturning restrains required and sheathing screws driven flush with the surface of the strapping.

SF 100

Story Drift Ratio

2

DS1

Sequential

Seq(DS1,DS2)

Local buckling of chord studs.

DS2

Sequential

Failure of many framing members and collapse.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

B1061.011-DS1-1.JPG

B1061.011-DS2-1.JPG

Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.0139

0.0179

0.25

0.25

0.1

0.25

NO

YES

Data Quality

Average

Documentation Quality

Average

Data Relevance

Superior

Rationality

Superior

Consequence Functions

Repair Description

Remove damaged wall, ceilings, X bracing as necessary, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work. Replace gypsum wall board, metal stud framing as needed, reinstall X bracing as required, tape and sand, repaint.

Remove damaged wall, ceilings, X bracing as necessary, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work. Replace gypsum wall board, boundary elements, metal stud framing, install X bracing, tape and sand, repaint.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

2.33E+03

3.12E+03

4.28E+03

3.14E+03

LogNormal

2.00

6.00

4.05E+03

2.49E+03

0.24

0.24

100 ft*2 Units

P₁₀

P₅₀

P₉₀

3.26E+03

3.78E+03

4.19E+03

3.74E+03

Normal

2.00

6.00

4.53E+03

3.21E+03

0.10

0.10

100 ft*2 Units

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

2.26E+00

3.03E+00

4.16E+00

3.03E+00

LogNormal

2.00

6.00

3.94E+00

2.43E+00

0.35

0.35

100 ft*2 Units

P₁₀

P₅₀

P₉₀

3.16E+00

3.66E+00

4.07E+00

3.66E+00

Normal

2.00

6.00

4.39E+00

3.11E+00

0.27

0.27

100 ft*2 Units

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

2.0E+03

LogNormal

0.35

2.3E+03

Normal

0.27

Median Cost

Best Fit

CV or Beta

2.5E+04

LogNormal

0.35

3.6E+04

Normal

0.27

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

YES

20%

0.50

NO

Not Applicable

0%

0.00

0%

0.00

YES

10%

0.50

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

100

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1061.011b

NISTIR Name

Cold formed steel walls with flat strap X-bracing, exterior - stucco one side

Description

Costing for each 100 ft*2 Wall Panel. Assumed framing: 33 mil cold formed steel framing with 4.5 inch x 33 mil flat strap X-bracing on one side. Straps attached to gussets with No. 8 screws.

Line 275

Construction Quality:

High quality

Seismic Installation Conditions:

Overturning restrains required and sheathing screws driven flush with the surface of the strapping.

Fragility Unit of Measure:

SF 100

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding

Round Qty? NO

Allow sum by floor or building? NO

Demand Location (floor above?) No

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Local buckling of chord studs.

Failure of many framing members and collapse.

Illustrations



B1061.011-DS1-1.JPG



B1061.011-DS2-1.JPG

Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.0139

0.0179

Data dispersion, β_d :

0.25

0.25

Uncertainty, β_u :

0.1

0.1

Total Dispersion, β :

0.25

0.25

Correlation (Yes / No)

NO

Data Quality Average

Documentation Quality Average

Directionality (Yes / No)

YES

Data Relevance Superior

Rationality Superior

Consequence Functions

Repair Description

Remove damaged wall, ceilings, X bracing as necessary, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work. Replace gypsum wall board, stucco, metal stud framing as needed, reinstall X bracing as required, tape and sand, repaint.

Remove damaged wall, ceilings, X bracing as necessary, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work. Replace gypsum wall board, stucco, boundary elements, metal stud framing, install X bracing, tape and sand, repaint.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.78E+03	3.08E+03	4.44E+03	4.63E+03	4.92E+03	6.35E+03									
Best fit mean:	3.36E+03			5.25E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00 8.00			3.00 8.00											
Average Repair Cost (Min Qty, Max Qty)	4.00E+03 2.46E+03			5.90E+03 4.18E+03											
CV or beta (Min Qty, Max Qty)	0.20 0.20			0.13 0.13											
Quantity Unit:	100 ft*2 Units			100 ft*2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.70E+00	2.98E+00	4.31E+00	4.50E+00	4.77E+00	6.16E+00									
Best fit mean:	2.98E+00			4.77E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00 8.00			3.00 8.00											
Average Repair Time (Min Qty, Max Qty)	3.88E+00 2.38E+00			5.72E+00 4.05E+00											
CV or beta (Min Qty, Max Qty)	0.32 0.32			0.28 0.28											
Quantity Unit:	100 ft*2 Units			100 ft*2 Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.1E+03	LogNormal	0.32	3.3E+03	LogNormal	0.28									
Embodied Energy (MJ)	2.7E+04	LogNormal	0.32	4.6E+04	LogNormal	0.28									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	20%	0.50		10%	0.50										

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

None

Root Cost Multiplier: 100

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1061.021a

Line 276

NISTIR Name
Description

Cold formed steel walls with 22 or 31 mil steel sheathing, interior - gypsum board
Costing for each 100 ft*2 Wall Panel. Assumed framing: 33 mil cold formed steel framing with 22 or 31 mil steel sheathing attached with No. 8 screws spaced 2" or 6" OC at perimeter and 12" OC EW in the field.

Construction Quality: High quality
Seismic Installation Conditions: Overturning restrains required and sheathing screws driven flush with the surface of the strapping.

Fragility Unit of Measure:	SF 100
Demand Parameter (unit):	Story Drift Ratio
Number of Damage States:	2

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Damage State:	DS1	DS2			
Type of Damage State:	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Pull out of sheathing fasteners from studs.	Buckling of steel sheathing. Buckling of framing members.			

Illustrations

				
B1061.021-DS1-1.JPG	B1061.021-DS2-1.JPG			
1.00	1.00			

Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, δ :	0.019	0.0253			
Data dispersion, β_d :	0.25	0.25			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.25	0.25			
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Superior		Rationality Superior	

Consequence Functions
Repair Description

Remove damaged wall, ceilings, wall finishes, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work. Replace 20% of fasteners, replace gypsum wall board, tape, sand, paint.

Remove damaged wall, ceilings, wall finishes, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work. Install new sheathing, new metal stud framing as needed, replace gypsum wall board, tape, sand, paint.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.10E+03	3.05E+03	4.67E+03	2.45E+03	4.15E+03	6.13E+03									
Best fit mean:	3.10E+03			4.24E+03											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	4.00			11.00											
Average Repair Cost (Min Qty, Max Qty)	3.97E+03			2.44E+03			4.98E+03			3.53E+03					
CV or beta (Min Qty, Max Qty)	0.32			0.32			0.34			0.34					
Quantity Unit:	100 ft*2 Units			100 ft*2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.04E+00	2.96E+00	4.53E+00	2.38E+00	4.03E+00	5.95E+00									
Best fit mean:	2.96E+00			4.03E+00											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	4.00			11.00											
Average Repair Time (Min Qty, Max Qty)	3.85E+00			2.37E+00			4.84E+00			3.43E+00					
CV or beta (Min Qty, Max Qty)	0.40			0.40			0.42			0.42					
Quantity Unit:	100 ft*2 Units			100 ft*2 Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.8E+03	LogNormal	0.40	2.2E+03	Normal	0.42									
Embodied Energy (MJ)	1.9E+04	LogNormal	0.40	3.1E+04	Normal	0.42									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	20% 0.50			10% 0.50											

Comments:
Date Created:
Approved (YES / NO)?
Official (YES / NO) ?
Author:
Revisions:

None
Not Given
By User
By User
Not Given
None

Root Cost Multiplier: 100
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1061.021b

NISTIR Name
Description

Cold formed steel walls with 22 or 31 mil steel sheathing, exterior - stucco one side
Costing for each 100 ft*2 Wall Panel. Assumed framing: 33 mil cold formed steel framing with 22 or 31 mil steel sheathing attached with No. 8 screws spaced 2" or 6" OC at perimeter and 12" OC EW in the field.

Line 277

Construction Quality: High quality
Seismic Installation Conditions: Overturning restrains required and sheathing screws driven flush with the surface of the strapping.

Fragility Unit of Measure:	SF 100
Demand Parameter (unit):	Story Drift Ratio Unit less
Number of Damage States:	2

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Damage State:	DS1	DS2			
Type of Damage State:	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Pull out of sheathing fasteners from studs.	Buckling of steel sheathing. Buckling of framing members.			

Illustrations

				
B1061.021-DS1-1.JPG	B1061.021-DS2-1.JPG			
1.00	1.00			

Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.019	0.0253			
Data dispersion, β_d :	0.25	0.25			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.25	0.25			
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Superior		Rationality Superior	

Consequence Functions
Repair Description

Remove damaged wall, ceilings, wall finishes, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work. Replace 20% of fasteners, replace gypsum wall board, stucco, tape, sand, paint.

Remove damaged wall, ceilings, wall finishes, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work. Install new sheathing, new metal stud framing as needed, replace gypsum wall board, stucco, tape, sand, paint.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.89E+03	2.31E+03	3.66E+03	4.09E+03	4.78E+03	6.23E+03									
Best fit mean:	2.51E+03			4.95E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	2.00 6.00			2.00 6.00											
Average Repair Cost (Min Qty, Max Qty)	3.00E+03 1.85E+03			5.73E+03 4.06E+03											
CV or beta (Min Qty, Max Qty)	0.28 0.28			0.17 0.17											
Quantity Unit:	100 ft*2 Units			100 ft*2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.84E+00	2.24E+00	3.55E+00	3.97E+00	4.63E+00	6.04E+00									
Best fit mean:	2.24E+00			4.63E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	2.00 6.00			2.00 6.00											
Average Repair Time (Min Qty, Max Qty)	2.91E+00 1.79E+00			5.56E+00 3.93E+00											
CV or beta (Min Qty, Max Qty)	0.38 0.38			0.30 0.30											
Quantity Unit:	100 ft*2 Units			100 ft*2 Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.0E+03	LogNormal	0.38	3.1E+03	LogNormal	0.30									
Embodied Energy (MJ)	2.1E+04	LogNormal	0.38	4.0E+04	LogNormal	0.30									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	20% 0.50			10% 0.50											

Comments:
Date Created:
Approved (YES / NO)?
Official (YES / NO) ?
Author:
Revisions:

None
Not Given
By User
By User
Not Given
None

Root Cost Multiplier: 100
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1071.001

NISTIR Name
Description

Light framed wood walls with structural panel sheathing, gypsum wallboard no hold-downs
Costing for each 100 ft*2 Wall Panel. Assumed framing: 1 SIDE: 3/8" OSB or 15/32 ply with 8d box nails at 4 to 6 inches along panel edges and 12 inches field nailing, DF #2, 2x4@16 studs. 1 SIDE: 1/2 gypsum board. Panel 8 feet tall, 8 or 16 feet long with or without door and window openings, double top plate, single bottom plate, no hold-downs.

Line 278

Construction Quality:	Not Specified					<div>Quantity RoundingRound Qty?NO</div> <div>Allow sum by floor or building?NO</div> <div>Demand Location (floor above?)No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	SF 100					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	3					
Damage State:	DS1		DS2		DS3	
Type of Damage State:	Sequential		Sequential		Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)					
Descriptions	Slight separation of sheathing or nails which come loose.		Permanent rotation of sheathing, tear out of nails or sheathing.		Fracture of studs, major sill plate cracking.	

Illustrations

				
B1071.001-DS1-1.JPG	B1071.001-DS2-1.JPG	B1071.001-DS3-1.JPG		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.01	0.0175	0.025		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	0.4	0.4	0.4		
Total Dispersion, β :	0.4	0.4	0.4		
Correlation (Yes / No)	NO	Data Quality Not Rated	Documentation Quality Average		
Directionality (Yes / No)	YES	Data Relevance Marginal	Rationality Superior		

Consequence Functions

Repair Description	Remove exterior pliable siding, replace loose nails, reinstall siding.	Remove exterior pliable siding, remove wood sheathing, install new sheathing, reinstall siding.	Remove and replace siding, sheathing, studs and plates. Provide shoring as required.
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Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.38E+03	1.64E+03	2.19E+03	1.71E+03	2.14E+03	2.93E+03	5.19E+03	5.38E+03	6.31E+03						
Best fit mean:	1.70E+03			2.20E+03			5.61E+03								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00		8.00	3.00		8.00	3.00		8.00						
Average Repair Cost (Min Qty, Max Qty)	2.13E+03		1.31E+03	2.57E+03		1.82E+03	6.45E+03		4.57E+03						
CV or beta (Min Qty, Max Qty)	0.19		0.19	0.22		0.22	0.08		0.08						
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.33E+00	1.59E+00	2.13E+00	1.66E+00	2.08E+00	2.84E+00	5.04E+00	5.22E+00	6.12E+00						
Best fit mean:	1.59E+00			2.08E+00			5.22E+00								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00		8.00	3.00		8.00	3.00		8.00						
Average Repair Time (Min Qty, Max Qty)	2.07E+00		1.27E+00	2.50E+00		1.77E+00	6.26E+00		4.44E+00						
CV or beta (Min Qty, Max Qty)	0.31		0.31	0.33		0.33	0.26		0.26						
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.8E+03	LogNormal	0.36	1.9E+03	LogNormal	0.45	2.2E+03	Normal	0.27						
Embodied Energy (MJ)	1.9E+04	LogNormal	0.36	2.2E+04	LogNormal	0.45	3.1E+04	Normal	0.27						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%		0.00	0%		0.00	0%		0.00						
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00	0%		0.00						
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00	50%		0.50	25%		0.50						

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Andre Filiatrault
Revisions: None

Root Cost Multiplier: 100
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1071.002

Line 281

NISTIR Name
Description

Light framed wood walls with structural panel sheathing, gypsum wallboard and hold-downs
Costing for each 100 ft*2 Wall Panel. Assumed framing: 1 SIDE: 3/8" OSB or 15/32 ply with 8d box nails at 4 to 6 inches along panel edges and 12 inches field nailing, DF #2, 2x4@16 studs. 1 SIDE: 1/2 gypsum board. Panel 8 feet tall, 8 or 16 feet long with or without door and window openings, double top plate, single bottom plate, with hold-downs.

Construction Quality:	Not Specified				
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	SF 100		Quantity Rounding Round Qty? NO		
Demand Parameter (unit):	Story Drift Ratio		Allow sum by floor or building? NO		
Number of Damage States:	3		Demand Location (floor above?) No		
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Slight separation of sheathing or nails which come loose.	Permanent rotation of sheathing, tear out of nails or sheathing.	Fracture of studs, major sill plate cracking.		

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, δ :	0.015	0.0262	0.0369		
Data dispersion, β_d :	0.26	0.16	0.17		
Uncertainty, β_u :	0.3	0.1	0.1		
Total Dispersion, β :	0.4	0.19	0.2		
Correlation (Yes / No)	NO		Data Quality Superior	Documentation Quality Superior	
Directionality (Yes / No)	YES		Data Relevance Superior	Rationality Superior	

Consequence Functions
Repair Description

Remove exterior pliable siding, replace loose nails, reinstall siding.
Remove exterior pliable siding, remove wood sheathing, install new sheathing, reinstall siding.
Remove and replace siding, sheathing, studs and plates. Provide shoring as required.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.38E+03	1.64E+03	2.19E+03	1.71E+03	2.14E+03	2.93E+03	5.19E+03	5.38E+03	6.31E+03						
Best fit mean:	1.70E+03			2.20E+03			5.61E+03								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00 8.00			3.00 8.00			3.00 8.00								
Average Repair Cost (Min Qty, Max Qty)	2.13E+03 1.31E+03			2.57E+03 1.82E+03			6.45E+03 4.57E+03								
CV or beta (Min Qty, Max Qty)	0.19 0.19			0.22 0.22			0.08 0.08								
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.33E+00	1.59E+00	2.13E+00	1.66E+00	2.08E+00	2.84E+00	5.04E+00	5.22E+00	6.12E+00						
Best fit mean:	1.59E+00			2.08E+00			5.22E+00								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00 8.00			3.00 8.00			3.00 8.00								
Average Repair Time (Min Qty, Max Qty)	2.07E+00 1.27E+00			2.50E+00 1.77E+00			6.26E+00 4.44E+00								
CV or beta (Min Qty, Max Qty)	0.31 0.31			0.33 0.33			0.26 0.26								
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.4E+03	LogNormal	0.31	2.0E+03	LogNormal	0.33	3.0E+03	LogNormal	0.26						
Embodied Energy (MJ)	2.4E+04	LogNormal	0.31	2.1E+04	LogNormal	0.33	3.9E+04	LogNormal	0.26						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			50% 0.50			25% 0.50								

Comments:

None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Andre Filiatrault
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable. 2016-09-14 Renamed from B1071.021

Root Cost Multiplier: 100
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1071.011

Line 280

NISTIR Name
Description

Light framed wood walls with structural panel sheathing, stucco no hold-downs
Costing for each 100 ft*2 Wall Panel. Assumed framing: 1 SIDE: 3/8" OSB or 15/32 ply with 8d box nails at 4 to 6 inches along panel edges and 12 inches field nailing. DF #2, 2x4@16 studs. 1 SIDE: 1/2 gypsum board. Panel 8 feet tall, 8 or 16 feet long with or without door and window openings, double top plate, single bottom plate, with no hold-downs. Three layer 7/8" stucco with 1/2-inch chop strand fibers applied over wire mesh fastened with 1.25 -inch long staples.

Construction Quality:
Seismic Installation Conditions:

Not Specified
Not Specified

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Fragility Unit of Measure:	SF 100				
Demand Parameter (unit):	Story Drift Ratio	Unit less			
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Cracking of stucco.	Spalling of stucco, separation of stucco and sheathing from studs.	Fracture of studs, major sill plate cracking.		

Illustrations

				
B1071.002-DS1-1.JPG	B1071.002-DS2-1.JPG	B1071.002-DS3-1.JPG		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, δ :	0.0017	0.0035	0.017		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	0.5	0.4	0.4		
Total Dispersion, β :	0.5	0.4	0.4		
Correlation (Yes / No)	NO	Data Quality Not Rated	Documentation Quality Average		
Directionality (Yes / No)	YES	Data Relevance Marginal	Rationality Superior		

Consequence Functions
Repair Description

Clean stucco cracks. Fill cracks with cement compound. Repaint wall to hide cracks.
Remove loose stucco and patch spalled areas with stucco. Repaint to hide repairs.
Remove and replace studs, plates, sheathing, and stucco. Shore as required.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.77E+03	2.30E+03	3.33E+03	1.67E+03	2.75E+03	4.35E+03	3.47E+03	4.50E+03	4.65E+03						
Best fit mean:	2.38E+03			2.72E+03			4.21E+03								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	2.00		6.00	2.00		6.00	2.00		6.00						
Average Repair Cost (Min Qty, Max Qty)	2.99E+03		1.84E+03	3.30E+03		2.34E+03	5.40E+03		3.83E+03						
CV or beta (Min Qty, Max Qty)	0.26		0.26	0.37		0.37	0.11		0.11						
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.71E+00	2.23E+00	3.24E+00	1.62E+00	2.67E+00	4.22E+00	3.36E+00	4.37E+00	4.51E+00						
Best fit mean:	2.23E+00			2.67E+00			4.37E+00								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	2.00		6.00	2.00		6.00	2.00		6.00						
Average Repair Time (Min Qty, Max Qty)	2.90E+00		1.78E+00	3.20E+00		2.27E+00	5.24E+00		3.71E+00						
CV or beta (Min Qty, Max Qty)	0.36		0.36	0.45		0.45	0.27		0.27						
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.8E+03	LogNormal	0.36	1.9E+03	LogNormal	0.45	2.2E+03	Normal	0.27						
Embodied Energy (MJ)	1.9E+04	LogNormal	0.36	2.2E+04	LogNormal	0.45	3.1E+04	Normal	0.27						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%		0.00	0%		0.00	0%		0.00						
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00	0%		0.00						
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00	35%		0.50	25%		0.50						

Comments:

None
Not Given
By User
By User
Andre Filiatrault
None

Root Cost Multiplier: 100
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1071.012

Line 279

NISTIR Name
Description

Light framed wood walls with structural panel sheathing, stucco, hold-downs
Costing for each 100 ft*2 Wall Panel. Assumed framing: 1 SIDE: 3/8" OSB or 15/32 ply with 8d box nails at 4 to 6 inches along panel edges and 12 inches field nailing. DF #2, 2x4@16 studs. 1 SIDE: 1/2 gypsum board. Panel 8 feet tall, 8 or 16 feet long with or without door and window openings, double top plate, single bottom plate, with hold-downs. Three layer 7/8" stucco with 1/2-inch chop strand fibers applied over wire mesh fastened with 1.25 -inch long staples.

Construction Quality:
Seismic Installation Conditions:

Not Specified
Not Specified

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Fragility Unit of Measure:	SF 100				
Demand Parameter (unit):	Story Drift Ratio	Unit less			
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Cracking of stucco.	Spalling of stucco, separation of stucco and sheathing from studs.	Fracture of studs, major sill plate cracking.		

Illustrations

				
B1071.002-DS1-1.JPG	B1071.002-DS2-1.JPG	B1071.002-DS3-1.JPG		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, δ :	0.0025	0.0052	0.0252		
Data dispersion, β_d :	Not Specified	0.28	0.12		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.44	0.3	0.16		
Correlation (Yes / No)	NO	Data Quality Superior	Documentation Quality Superior		
Directionality (Yes / No)	YES	Data Relevance Superior	Rationality Superior		

Consequence Functions
Repair Description

Clean stucco cracks. Fill cracks with cement compound. Repaint wall to hide cracks.
Remove loose stucco and patch spalled areas with stucco. Repaint to hide repairs.
Remove and replace studs, plates, sheathing, and stucco. Shore as required.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.77E+03	2.30E+03	3.33E+03	1.67E+03	2.75E+03	4.35E+03	3.47E+03	4.50E+03	4.65E+03						
Best fit mean:	2.38E+03 LogNormal			2.72E+03 LogNormal			4.21E+03 Normal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	2.00 6.00			2.00 6.00			2.00 6.00								
Average Repair Cost (Min Qty, Max Qty)	2.99E+03 1.84E+03			3.30E+03 2.34E+03			5.40E+03 3.83E+03								
CV or beta (Min Qty, Max Qty)	0.26 0.26			0.37 0.37			0.11 0.11								
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.71E+00	2.23E+00	3.24E+00	1.62E+00	2.67E+00	4.22E+00	3.36E+00	4.37E+00	4.51E+00						
Best fit mean:	2.23E+00 LogNormal			2.67E+00 LogNormal			4.37E+00 Normal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	2.00 6.00			2.00 6.00			2.00 6.00								
Average Repair Time (Min Qty, Max Qty)	2.90E+00 1.78E+00			3.20E+00 2.27E+00			5.24E+00 3.71E+00								
CV or beta (Min Qty, Max Qty)	0.36 0.36			0.45 0.45			0.27 0.27								
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.4E+03	LogNormal	0.31	2.0E+03	LogNormal	0.33	3.0E+03	LogNormal	0.28						
Embodied Energy (MJ)	2.4E+04	LogNormal	0.31	2.1E+04	LogNormal	0.33	3.9E+04	LogNormal	0.28						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			35% 0.50			25% 0.50								

Comments:

None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Andre Filiatrault
Revisions: 2016-09-14 Renamed from B1071.002

Root Cost Multiplier: 100
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B1071.031

Line 282

NISTIR Name
Description

Wood walls with diagonal let-in bracing
Costing for each 100 ft^2 Wall Panel. Assumed framing: Stud wall framing consists of 2 x 4's at 16 inches on center with double top plates and single sill plate. Diagonal bracing includes 2 forms. Block-bracing consists of diagonal blocking between studs that extends from the top of one edge of the panel to the bottom of the opposite edge. Diagonal bracing may also consist of let-in bracing for which a 1x or 2x brace (with same inclination as described for block-bracing) is recessed into studs. Walls may be sheathed with horizontal or vertical lumber siding.

Construction Quality:
Seismic Installation Conditions:

Not Specified
Not Specified

Fragility Unit of Measure: SF 100
Demand Parameter (unit): Story Drift Ratio Unit less

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	NO	

Number of Damage States:	1				
Damage State:	DS1				
Type of Damage State:	Sequential				
DS Hierarchy	Seq(DS1)				
Descriptions	Failure of diagonal bracing.				

Illustrations

				
B1071.031-DS1-1.JPG				

Damage State Probability:	1.00				
Fragility Parameters					
Median Demand, θ :	0.01				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	0.4				
Total Dispersion, β :	0.4				
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Average		Rationality Superior	

Consequence Functions
Repair Description

Remove and replace sheathing studs, plates and bracing and replace with new stud wall construction of plywood, hold-downs, etc. Provide shoring as required.

Long Lead Time (Yes / No)

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	4.01E+03	4.74E+03	5.27E+03												
Best fit mean:	4.68E+03														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	4.00		11.00												
Average Repair Cost (Min Qty, Max Qty)	6.16E+03		3.79E+03												
CV or beta (Min Qty, Max Qty)	0.11		0.11												
Quantity Unit:	100 ft^2 Units														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	3.89E+00	4.60E+00	5.12E+00												
Best fit mean:	4.60E+00														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	4.00		11.00												
Average Repair Time (Min Qty, Max Qty)	5.98E+00		3.68E+00												
CV or beta (Min Qty, Max Qty)	0.27		0.27												
Quantity Unit:	100 ft^2 Units														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.2E+03	Normal	0.27												
Embodied Energy (MJ)	3.0E+04	Normal	0.27												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	YES														
Unsafe Placard Trigger (Median, Dispersion)	25%	0.50													

Comments:

None

Date Created:
Approved (YES / NO)?

Not Given
By User

Official (YES / NO) ?
Author:

By User
Andre Filiatrault

Revisions:

None

Root Cost Multiplier: 100
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification B1071.041

NISTIR Name Exterior Wall - Type: Gypsum with wood studs, Full Height, Fixed Below, Fixed Above

Description Costing based upon 13'x100' Panels

Line 283

Construction Quality:	Normal				
Seismic Installation Conditions:	Unknown				
Fragility Unit of Measure:	LF 100				
Demand Parameter (unit):	Story Drift Ratio				
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Screws pop-out, minor cracking of wall board, warping or cracking of tape. Moderate cracking or crushing of gypsum wall boards (typically in corners and in corners of openings). Significant cracking and/or crushing of gypsum wall boards- buckling of studs and tearing of tracks.				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	NO	NO

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.0021	0.0071	0.012		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified		
Total Dispersion, β :	0.6	0.45	0.45		
Correlation (Yes / No)	NO	Data Quality Superior	Documentation Quality Superior		
Directionality (Yes / No)	YES	Data Relevance Superior	Rationality Not Rated		

Consequence Functions

Repair Description	Retape joints, paste and repaint both sides of full 100 foot length of wall board.	Remove full 100 foot length of wall board (both sides), install new wall board (both sides), tape, paste and repaint.	Remove and replace full 100 foot length of metal stud wall, both sides of the gypsum wall board and any embedded utilities, and tape, paste and repaint.
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Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	7.00E+02	2.17E+03	3.00E+03	2.05E+03	5.55E+03	8.90E+03	1.80E+04	1.88E+04	2.28E+04						
Best fit mean:	1.96E+03			5.50E+03			1.98E+04								
Best Fit Distribution:	Normal			Normal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00 10.00			1.00 10.00			1.00 10.00								
Average Repair Cost (Min Qty, Max Qty)	4.34E+03 1.30E+03			1.11E+04 3.33E+03			3.76E+04 1.13E+04								
CV or beta (Min Qty, Max Qty)	0.46 0.46			0.49 0.49			0.10 0.10								
Quantity Unit:	Each (13'x100' Panel)			Each (13'x100' Panel)			Each (13'x100' Panel)								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.20E+01	1.69E+00	2.34E+00	1.56E+00	4.29E+00	6.89E+00	1.40E+01	1.47E+01	1.78E+01						
Best fit mean:	1.52E+00			4.25E+00			1.54E+01								
Best Fit Distribution:	Normal			Normal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00 10.00			1.00 10.00			1.00 10.00								
Average Repair Time (Min Qty, Max Qty)	3.38E+00 1.01E+00			8.62E+00 2.56E+00			2.93E+01 8.83E+00								
CV or beta (Min Qty, Max Qty)	0.52 0.52			0.55 0.55			0.27 0.27								
Quantity Unit:	Each (13'x100' Panel)			Each (13'x100' Panel)			Each (13'x100' Panel)								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.3E+02	Normal	0.52	6.6E+02	Normal	0.55	3.5E+04	LogNormal	0.27						
Embodied Energy (MJ)	5.6E+03	Normal	0.52	1.7E+04	Normal	0.55	3.4E+05	LogNormal	0.27						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			NO								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							

Comments: Copy of C1011.011a for use as an exterior wall.

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Not Given

Revisions: None

Root Cost Multiplier: 1300

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B2011.001a

Line 284

NISTIR Name

Exterior Wall - Cold formed steel walls with wood structural panel sheathing, interior - gypsum board

Description

Costing for each 100 ft*2 Wall Panel. Assumed framing: 38 mil cold formed steel framing with 7/16 OSB and 3/8 plywood panel sheathing with overturning restraint at each end of the wall per AISI design standard. No. 8 screws 2" to 6" OC at perimeter and 12" OC EW in field.

Construction Quality:

High quality

Seismic Installation Conditions:

Overturning restraint at each end of wall.

Fragility Unit of Measure:

SF 100

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

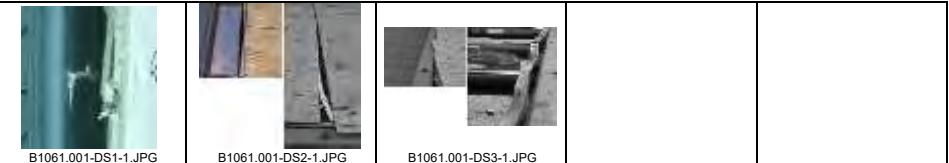
Descriptions

Sheathing faster pull through or tear out. (20% of fasteners.)

Failure of structural panels.

Failure of wall.

Illustrations



Damage State Probability:

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.004

0.0226

0.0267

Data dispersion, β_d :

0.4

0.30

0.25

Uncertainty, β_u :

0.1

0.1

0.1

Total Dispersion, β :

0.4

0.3

0.25

Correlation (Yes / No)

NO

Directionality (Yes / No)

YES

Data Quality Superior

Data Relevance Superior

Documentation Quality Superior

Rationality Superior

Consequence Functions

Repair Description

Remove damaged wall, ceilings, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work. Replace 20% of fasteners, replace gypsum wall board, tape and sand, repaint.

Remove damaged wall, ceilings, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work. Replace sheathing, replace gypsum wall board, tape and sand, repaint.

Remove damaged wall, ceilings, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Provide shoring. Modify mechanical and electrical as required for repair work. Replace metal stud framing, boundary elements, sheathing, replace gypsum wall board, tape and sand, repaint.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.10E+03	3.05E+03	4.67E+03	2.00E+03	3.50E+03	5.68E+03	3.47E+03	4.50E+03	4.65E+03						
Best fit mean:	3.10E+03 LogNormal			3.43E+03 LogNormal			4.21E+03 Normal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	6.00 30.00			6.00 30.00			6.00 30.00								
Average Repair Cost (Min Qty, Max Qty)	3.97E+03 2.44E+03			4.20E+03 2.98E+03			5.40E+03 3.83E+03								
CV or beta (Min Qty, Max Qty)	0.32 0.32			0.40 0.40			0.11 0.11								
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.64E+00	2.38E+00	3.64E+00	1.56E+00	2.73E+00	4.43E+00	2.70E+00	3.51E+00	3.62E+00						
Best fit mean:	2.38E+00 LogNormal			2.73E+00 LogNormal			3.51E+00 Normal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	6.00 30.00			6.00 30.00			6.00 30.00								
Average Repair Time (Min Qty, Max Qty)	3.09E+00 1.90E+00			3.28E+00 2.32E+00			4.21E+00 2.98E+00								
CV or beta (Min Qty, Max Qty)	0.40 0.40			0.47 0.47			0.27 0.27								
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.8E+03	LogNormal	0.40	1.9E+03	LogNormal	0.47	2.5E+03	Normal	0.27						
Embodied Energy (MJ)	1.9E+04	LogNormal	0.40	2.2E+04	LogNormal	0.47	3.9E+04	Normal	0.27						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			25% 0.50			10% 0.50								

Comments:

Copy of B1061.001a for use as an exterior wall.

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

None

Root Cost Multiplier: 100

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B2011.001b

Line 285

NISTIR Name
Description

Exterior Wall - Cold formed steel walls with wood structural panel sheathing, exterior - stucco one side
Costing for each 100 ft*2 Wall Panel. Assumed framing: 38 mil cold formed steel framing with 7/16 OSB and 3/8 plywood panel sheathing with overturning restraint at each end of the wall per AISI design standard. No. 8 screws 2" to 6" OC at perimeter and 12" OC EW in field.

Construction Quality:

High quality

Seismic Installation Conditions:

Overturning restraint at each end of wall.

Fragility Unit of Measure:

SF 100

Demand Parameter (unit):

Story Drift Ratio Unit less

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

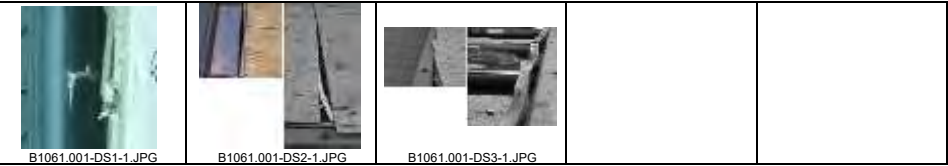
Sheathing faster pull through or tear out. (20% of fasteners.)

Failure of structural panels.

Failure of wall.

Quantity Rounding Round Qty? NO
Allow sum by floor or building? NO
Demand Location (floor above?) No

Illustrations



Damage State Probability:

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.004

0.0226

0.0267

Data dispersion, β_d :

0.4

0.30

0.25

Uncertainty, β_u :

0.1

0.1

0.1

Total Dispersion, β :

0.4

0.3

0.25

Correlation (Yes / No)

NO

Data Quality Superior

Documentation Quality Superior

Directionality (Yes / No)

YES

Data Relevance Superior

Rationality Superior

Consequence Functions

Repair Description

Remove damaged wall, ceilings, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work. Replace 20% of fasteners, replace gypsum wall board, stucco, tape and sand, repaint.

Remove damaged wall, ceilings, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work. Replace sheathing, replace gypsum wall board, stucco, tape and sand, repaint.

Remove damaged wall, ceilings, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Provide shoring. Modify mechanical and electrical as required for repair work. Replace metal stud framing, boundary elements, sheathing, replace gypsum wall board, stucco, tape and sand, repaint.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.76E+03	2.19E+03	2.98E+03	3.41E+03	3.83E+03	6.06E+03	4.59E+03	5.38E+03	5.96E+03						
Best fit mean:	2.25E+03 LogNormal			4.27E+03 LogNormal			5.31E+03 Normal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	6.00 30.00			6.00 30.00			6.00 30.00								
Average Repair Cost (Min Qty, Max Qty)	2.85E+03 1.75E+03			4.59E+03 3.25E+03			6.45E+03 4.57E+03								
CV or beta (Min Qty, Max Qty)	0.21 0.21			0.25 0.25			0.10 0.10								
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.37E+00	1.71E+00	2.32E+00	2.66E+00	2.98E+00	4.72E+00	3.58E+00	4.19E+00	4.64E+00						
Best fit mean:	1.71E+00 LogNormal			2.98E+00 LogNormal			4.19E+00 Normal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	6.00 30.00			6.00 30.00			6.00 30.00								
Average Repair Time (Min Qty, Max Qty)	2.22E+00 1.37E+00			3.58E+00 2.53E+00			5.03E+00 3.56E+00								
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.35 0.35			0.27 0.27								
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.0E+03	LogNormal	0.33	2.8E+03	LogNormal	0.35	3.4E+03	Normal	0.27						
Embodied Energy (MJ)	2.1E+04	LogNormal	0.33	3.1E+04	LogNormal	0.35	4.8E+04	Normal	0.27						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			25% 0.50			10% 0.50								

Comments:

Copy of B1061.001b for use as an exterior wall.

Date Created:
Approved (YES / NO)?
Official (YES / NO) ?
Author:
Revisions:

Not Given
By User
By User
Not Given
None

Root Cost Multiplier: 100
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2011.011a

Exterior Wall - Cold formed steel walls with flat strap X-bracing, interior - gypsum board

Costing for each 100 ft*2 Wall Panel. Assumed framing: 33 mil cold formed steel framing with 4.5 inch x 33 mil flat strap X-bracing on one side. Straps attached to gussets with No. 8 screws.

Line 286

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

High quality

Overturning restrains required and sheathing screws driven flush with the surface of the strapping.

SF 100

Story Drift Ratio

2

DS1

Sequential

Seq(DS1,DS2)

Local buckling of chord studs.

DS2

Sequential

Failure of many framing members and collapse.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

B1061.011-DS1-1.JPG

B1061.011-DS2-1.JPG

Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

NO

YES

Data Quality

Average

Documentation Quality

Average

Data Relevance

Superior

Rationality

Superior

Consequence Functions

Repair Description

Remove damaged wall, ceilings, X bracing as necessary, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work. Replace gypsum wall board, metal stud framing as needed, reinstall X bracing as required, tape and sand, repaint.

Remove damaged wall, ceilings, X bracing as necessary, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work. Replace gypsum wall board, boundary elements, metal stud framing, install X bracing, tape and sand, repaint.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

100 ft*2 Units

P₁₀

P₅₀

P₉₀

2.33E+03

3.12E+03

4.28E+03

P₁₀

P₅₀

P₉₀

3.26E+03

3.78E+03

4.19E+03

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

100 ft*2 Units

P₁₀

P₅₀

P₉₀

1.81E+00

2.43E+00

3.34E+00

P₁₀

P₅₀

P₉₀

2.54E+00

2.94E+00

3.27E+00

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

2.0E+03

LogNormal

0.35

Median Cost

Best Fit

CV or Beta

2.3E+03

Normal

0.27

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

YES

20%

NO

Not Applicable

0%

0.00

0%

0.00

YES

10%

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

Copy of B1061.011a for use as an exterior wall.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

100

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2011.011b

Exterior Wall - Cold formed steel walls with flat strap X-bracing, exterior - stucco one side

Costing for each 100 ft*2 Wall Panel. Assumed framing: 33 mil cold formed steel framing with 4.5 inch x 33 mil flat strap X-bracing on one side. Straps attached to gussets with No. 8 screws.

Line 287

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

High quality

Overturning restrains required and sheathing screws driven flush with the surface of the strapping.

SF 100

Story Drift Ratio

2

DS1

Sequential

Seq(DS1,DS2)

Local buckling of chord studs.

DS2

Sequential

Failure of many framing members and collapse.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

B1061.011-DS1-1.JPG

B1061.011-DS2-1.JPG

Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.0139

0.0179

0.25

0.25

0.1

0.25

NO

YES

Data Quality

Average

Documentation Quality

Average

Data Relevance

Superior

Rationality

Superior

Consequence Functions

Repair Description

Remove damaged wall, ceilings, X bracing as necessary, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work. Replace gypsum wall board, stucco, metal stud framing as needed, reinstall X bracing as required, tape and sand, repaint.

Remove damaged wall, ceilings, X bracing as necessary, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work. Replace gypsum wall board, stucco, boundary elements, metal stud framing, install X bracing, tape and sand, repaint.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

2.78E+03

3.08E+03

4.44E+03

3.36E+03

LogNormal

3.00

8.00

4.00E+03

0.20

100 ft*2 Units

P₁₀

P₅₀

P₉₀

4.63E+03

4.92E+03

6.35E+03

5.25E+03

LogNormal

3.00

8.00

5.90E+03

0.13

100 ft*2 Units

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

2.17E+00

2.40E+00

3.46E+00

2.40E+00

LogNormal

3.00

8.00

3.12E+00

0.32

100 ft*2 Units

P₁₀

P₅₀

P₉₀

3.61E+00

3.83E+00

4.95E+00

3.83E+00

LogNormal

3.00

8.00

4.60E+00

0.28

100 ft*2 Units

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

2.1E+03

LogNormal

0.32

2.7E+04

LogNormal

0.32

Median Cost

Best Fit

CV or Beta

3.3E+03

LogNormal

0.28

4.6E+04

LogNormal

0.28

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

YES

20%

NO

Not Applicable

0%

0.00

0%

0.00

YES

10%

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

Copy of B1061.011b for use as an exterior wall.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

100

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B2011.021a

Line 288

NISTIR Name

Exterior Wall - Cold formed steel walls with 22 or 31 mil steel sheathing, interior - gypsum board

Description

Costing for each 100 ft*2 Wall Panel. Assumed framing: 33 mil cold formed steel framing with 22 or 31 mil steel sheathing attached with No. 8 screws spaced 2" or 6" OC at perimeter and 12" OC EW in the field.

Construction Quality:

High quality

Seismic Installation Conditions:

Overturning restrains required and sheathing screws driven flush with the surface of the strapping.

Fragility Unit of Measure:

SF 100

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding Round Qty? NO

Allow sum by floor or building? NO

Demand Location (floor above?) No

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Pull out of sheathing fasteners from studs.

Buckling of steel sheathing. Buckling of framing members.

Illustrations



Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.019

0.0253

Data dispersion, β_d :

0.25

0.25

Uncertainty, β_u :

0.1

0.1

Total Dispersion, β :

0.25

0.25

Correlation (Yes / No)

NO

Data Quality Average

Documentation Quality Superior

Directionality (Yes / No)

YES

Data Relevance Superior

Rationality Superior

Consequence Functions

Repair Description

Remove damaged wall, ceilings, wall finishes, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work. Replace 20% of fasteners, replace gypsum wall board, tape, sand, paint.

Remove damaged wall, ceilings, wall finishes, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work. Install new sheathing, new metal stud framing as needed, replace gypsum wall board, tape, sand, paint.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.10E+03	3.05E+03	4.67E+03	2.45E+03	4.15E+03	6.13E+03									
Best fit mean:	3.10E+03 LogNormal			4.24E+03 Normal											
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	4.00 11.00			4.00 11.00											
Average Repair Cost (Min Qty, Max Qty)	3.97E+03 2.44E+03			4.98E+03 3.53E+03											
CV or beta (Min Qty, Max Qty)	0.32 0.32			0.34 0.34											
Quantity Unit:	100 ft*2 Units			100 ft*2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.64E+00	2.38E+00	3.64E+00	1.91E+00	3.23E+00	4.78E+00									
Best fit mean:	2.38E+00 LogNormal			3.23E+00 Normal											
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	4.00 11.00			4.00 11.00											
Average Repair Time (Min Qty, Max Qty)	3.09E+00 1.90E+00			3.88E+00 2.74E+00											
CV or beta (Min Qty, Max Qty)	0.40 0.40			0.42 0.42											
Quantity Unit:	100 ft*2 Units			100 ft*2 Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.8E+03	LogNormal	0.40	2.2E+03	Normal	0.42									
Embodied Energy (MJ)	1.9E+04	LogNormal	0.40	3.1E+04	Normal	0.42									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	20% 0.50			10% 0.50											

Comments:

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Date Created:

Not Given

Root Cost Multiplier: 100

Approved (YES / NO)?

By User

Date Generated: 02/26/19

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

None

FEMA P-58 Fragility Specification

NISTIR Classification

B2011.021b

NISTIR Name

Exterior Wall - Cold formed steel walls with 22 or 31 mil steel sheathing, exterior - stucco one side

Description

Costing for each 100 ft*2 Wall Panel. Assumed framing: 33 mil cold formed steel framing with 22 or 31 mil steel sheathing attached with No. 8 screws spaced 2" or 6" OC at perimeter and 12" OC EW in the field.

Line 289

Construction Quality:

High quality

Seismic Installation Conditions:

Overturning restrains required and sheathing screws driven flush with the surface of the strapping.

Fragility Unit of Measure:

SF 100

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding

Round Qty? NO

Allow sum by floor or building? NO

Demand Location (floor above?) No

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Pull out of sheathing fasteners from studs.

Buckling of steel sheathing. Buckling of framing members.

Illustrations



Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.019

0.0253

Data dispersion, β_d :

0.25

0.25

Uncertainty, β_u :

0.1

0.1

Total Dispersion, β :

0.25

0.25

Correlation (Yes / No)

NO

Data Quality Average

Documentation Quality Superior

Directionality (Yes / No)

YES

Data Relevance Superior

Rationality Superior

Consequence Functions

Repair Description

Remove damaged wall, ceilings, wall finishes, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work. Replace 20% of fasteners, replace gypsum wall board, stucco, tape, sand, paint.

Remove damaged wall, ceilings, wall finishes, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work. Install new sheathing, new metal stud framing as needed, replace gypsum wall board, stucco, tape, sand, paint.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.89E+03	2.31E+03	3.66E+03	4.09E+03	4.78E+03	6.23E+03									
Best fit mean:	2.51E+03			4.95E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	2.00 6.00			2.00 6.00											
Average Repair Cost (Min Qty, Max Qty)	3.00E+03 1.85E+03			5.73E+03 4.06E+03											
CV or beta (Min Qty, Max Qty)	0.28 0.28			0.17 0.17											
Quantity Unit:	100 ft*2 Units			100 ft*2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.47E+00	1.80E+00	2.85E+00	3.19E+00	3.72E+00	4.85E+00									
Best fit mean:	1.80E+00			3.72E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	2.00 6.00			2.00 6.00											
Average Repair Time (Min Qty, Max Qty)	2.34E+00 1.44E+00			4.46E+00 3.16E+00											
CV or beta (Min Qty, Max Qty)	0.38 0.38			0.30 0.30											
Quantity Unit:	100 ft*2 Units			100 ft*2 Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.0E+03	LogNormal	0.38	3.1E+03	LogNormal	0.30									
Embodied Energy (MJ)	2.1E+04	LogNormal	0.38	4.0E+04	LogNormal	0.30									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	20% 0.50			10% 0.50											

Comments:

Copy of B1061.021b for use as an exterior wall.

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

None

Root Cost Multiplier: 100

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B2011.101

Line 290

NISTIR Name
Description

Exterior Wall - Light framed wood walls with structural panel sheathing, gypsum wallboard no hold-downs
Costing for each 100 ft*2 Wall Panel. Assumed framing: 1 SIDE: 3/8" OSB or 15/32 ply with 8d box nails at 4 to 6 inches along panel edges and 12 inches field nailing, DF #2, 2x4@16 studs. 1 SIDE: 1/2 gypsum board. Panel 8 feet tall, 8 or 16 feet long with or without door and window openings, double top plate, single bottom plate, no hold-downs.

Construction Quality:	Not Specified				
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	SF 100		Quantity Rounding Round Qty? NO		
Demand Parameter (unit):	Story Drift Ratio		Allow sum by floor or building? NO		
Number of Damage States:	3		Demand Location (floor above?) No		
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Slight separation of sheathing or nails which come loose.	Permanent rotation of sheathing, tear out of nails or sheathing.	Fracture of studs, major sill plate cracking.		

Illustrations

				
B1071.001-DS1-1.JPG	B1071.001-DS2-1.JPG	B1071.001-DS3-1.JPG		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.01	0.0175	0.025		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	0.4	0.4	0.4		
Total Dispersion, β :	0.4	0.4	0.4		
Correlation (Yes / No)	NO	Data Quality Not Rated	Documentation Quality Average		
Directionality (Yes / No)	YES	Data Relevance Marginal	Rationality Superior		

Consequence Functions

Repair Description	Remove exterior pliable siding, replace loose nails, reinstall siding.	Remove exterior pliable siding, remove wood sheathing, install new sheathing, reinstall siding.	Remove and replace siding, sheathing, studs and plates. Provide shoring as required.
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Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.77E+03	2.30E+03	3.33E+03	1.67E+03	2.75E+03	4.35E+03	3.47E+03	4.50E+03	4.65E+03						
Best fit mean:	2.38E+03			2.72E+03			4.21E+03								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00		8.00	3.00		8.00	3.00		8.00						
Average Repair Cost (Min Qty, Max Qty)	2.99E+03		1.84E+03	3.30E+03		2.34E+03	5.40E+03		3.83E+03						
CV or beta (Min Qty, Max Qty)	0.26		0.26	0.37		0.37	0.11		0.11						
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.38E+00	1.79E+00	2.60E+00	1.30E+00	2.14E+00	3.39E+00	2.70E+00	3.51E+00	3.62E+00						
Best fit mean:	1.79E+00			2.14E+00			3.51E+00								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00		8.00	3.00		8.00	3.00		8.00						
Average Repair Time (Min Qty, Max Qty)	2.33E+00		1.43E+00	2.57E+00		1.82E+00	4.21E+00		2.98E+00						
CV or beta (Min Qty, Max Qty)	0.36		0.36	0.45		0.45	0.27		0.27						
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.8E+03	LogNormal	0.36	1.9E+03	LogNormal	0.45	2.2E+03	Normal	0.27						
Embodied Energy (MJ)	1.9E+04	LogNormal	0.36	2.2E+04	LogNormal	0.45	3.1E+04	Normal	0.27						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%		0.00	0%		0.00	0%		0.00						
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00	0%		0.00						
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00	50%		0.50	25%		0.50						

Comments:	Copy of B1071.001 for use as an exterior wall.				
Date Created:	Not Given				
Approved (YES / NO)?	By User				
Official (YES / NO) ?	By User				
Author:	Andre Filiatrault				
Revisions:	None				
			Root Cost Multiplier:	100	
			Date Generated:	02/26/19	

FEMA P-58 Fragility Specification

NISTIR Classification

B2011.102

Line 291

NISTIR Name
Description

Exterior Wall - Light framed wood walls with structural panel sheathing, stucco, hold-downs
Costing for each 100 ft*2 Wall Panel. Assumed framing: 1 SIDE: 3/8" OSB or 15/32 ply with 8d box nails at 4 to 6 inches along panel edges and 12 inches field nailing. DF #2, 2x4@16 studs. 1 SIDE: 1/2 gypsum board. Panel 8 feet tall, 8 or 16 feet long with or without door and window openings, double top plate, single bottom plate, with hold-downs. Three layer 7/8" stucco with 1/2-inch chop strand fibers applied over wire mesh fastened with 1.25 -inch long staples.

Construction Quality:
Seismic Installation Conditions:

Not Specified
Not Specified

Fragility Unit of Measure:	SF 100
Demand Parameter (unit):	Story Drift Ratio
Number of Damage States:	3

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	NO	

Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Cracking of stucco.	Spalling of stucco, separation of stucco and sheathing from studs.	Fracture of studs, major sill plate cracking.		

Illustrations

				
B1071.002-DS1-1.JPG	B1071.002-DS2-1.JPG	B1071.002-DS3-1.JPG		

Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, δ :	0.0025	0.0052	0.0252		
Data dispersion, β_d :	0.43	0.28	0.12		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.44	0.3	0.16		
Correlation (Yes / No)	NO	Data Quality Superior	Documentation Quality Superior		
Directionality (Yes / No)	YES	Data Relevance Superior	Rationality Superior		

Consequence Functions
Repair Description

Clean stucco cracks. Fill cracks with cement compound. Repaint wall to hide cracks.
Remove loose stucco and patch spalled areas with stucco. Repaint to hide repairs.
Remove and replace studs, plates, sheathing, and stucco. Shore as required.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.38E+03	1.64E+03	2.19E+03	1.71E+03	2.14E+03	2.93E+03	4.27E+03	4.80E+03	5.70E+03						
Best fit mean:	1.70E+03			2.20E+03			4.89E+03								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	4.00 11.00			4.00 11.00			4.00 11.00								
Average Repair Cost (Min Qty, Max Qty)	2.13E+03 1.31E+03			2.57E+03 1.82E+03			5.76E+03 4.08E+03								
CV or beta (Min Qty, Max Qty)	0.19 0.19			0.22 0.22			0.12 0.12								
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.07E+00	1.28E+00	1.71E+00	1.33E+00	1.67E+00	2.28E+00	3.33E+00	3.74E+00	4.44E+00						
Best fit mean:	1.28E+00			1.67E+00			3.74E+00								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	4.00 11.00			4.00 11.00			4.00 11.00								
Average Repair Time (Min Qty, Max Qty)	1.66E+00 1.02E+00			2.00E+00 1.42E+00			4.49E+00 3.18E+00								
CV or beta (Min Qty, Max Qty)	0.31 0.31			0.33 0.33			0.28 0.28								
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.4E+03	LogNormal	0.31	2.0E+03	LogNormal	0.33	3.0E+03	LogNormal	0.28						
Embodied Energy (MJ)	2.4E+04	LogNormal	0.31	2.1E+04	LogNormal	0.33	3.9E+04	LogNormal	0.28						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			35% 0.50			25% 0.50								

Comments:

Copy of B1071.002 for use as an exterior wall.

Date Created:
Approved (YES / NO)?
Official (YES / NO) ?
Author:
Revisions:

Not Given
By User
By User
Andre Filiatrault
None

Root Cost Multiplier: 100
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B2011.111

Line 292

NISTIR Name
Description

Exterior Wall - Light framed wood walls with structural panel sheathing, stucco no hold-downs
Costing for each 100 ft*2 Wall Panel. Assumed framing: 1 SIDE: 3/8" OSB or 15/32 ply with 8d box nails at 4 to 6 inches along panel edges and 12 inches field nailing. DF #2, 2x4@16 studs. 1 SIDE: 1/2 gypsum board. Panel 8 feet tall, 8 or 16 feet long with or without door and window openings, double top plate, single bottom plate, with no hold-downs. Three layer 7/8" stucco with 1/2-inch chop strand fibers applied over wire mesh fastened with 1.25 -inch long staples.

Construction Quality:
Seismic Installation Conditions:

Not Specified
Not Specified

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Fragility Unit of Measure:	SF 100				
Demand Parameter (unit):	Story Drift Ratio	Unit less			
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Cracking of stucco.	Spalling of stucco, separation of stucco and sheathing from studs.	Fracture of studs, major sill plate cracking.		

Illustrations

				
B1071.002-DS1-1.JPG	B1071.002-DS2-1.JPG	B1071.002-DS3-1.JPG		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, δ :	0.0017	0.0035	0.017		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	0.5	0.4	0.4		
Total Dispersion, β :	0.5	0.4	0.4		
Correlation (Yes / No)	NO	Data Quality Not Rated	Documentation Quality Average		
Directionality (Yes / No)	YES	Data Relevance Marginal	Rationality Superior		

Consequence Functions
Repair Description

Clean stucco cracks. Fill cracks with cement compound. Repaint wall to hide cracks.
Remove loose stucco and patch spalled areas with stucco. Repaint to hide repairs.
Remove and replace studs, plates, sheathing, and stucco. Shore as required.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.77E+03	2.30E+03	3.33E+03	1.67E+03	2.75E+03	4.35E+03	3.47E+03	4.50E+03	4.65E+03						
Best fit mean:	2.38E+03			2.72E+03			4.21E+03								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	2.00		6.00	2.00		6.00	2.00		6.00						
Average Repair Cost (Min Qty, Max Qty)	2.99E+03		1.84E+03	3.30E+03		2.34E+03	5.40E+03		3.83E+03						
CV or beta (Min Qty, Max Qty)	0.26		0.26	0.37		0.37	0.11		0.11						
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.38E+00	1.79E+00	2.60E+00	1.30E+00	2.14E+00	3.39E+00	2.70E+00	3.51E+00	3.62E+00						
Best fit mean:	1.79E+00			2.14E+00			3.51E+00								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	2.00		6.00	2.00		6.00	2.00		6.00						
Average Repair Time (Min Qty, Max Qty)	2.33E+00		1.43E+00	2.57E+00		1.82E+00	4.21E+00		2.98E+00						
CV or beta (Min Qty, Max Qty)	0.36		0.36	0.45		0.45	0.27		0.27						
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.8E+03	LogNormal	0.36	1.9E+03	LogNormal	0.45	2.2E+03	Normal	0.27						
Embodied Energy (MJ)	1.9E+04	LogNormal	0.36	2.2E+04	LogNormal	0.45	3.1E+04	Normal	0.27						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%		0.00	0%		0.00	0%		0.00						
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00	0%		0.00						
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00	35%		0.50	25%		0.50						

Comments:

Copy of B1071.011 for use as an exterior wall.

Date Created:
Approved (YES / NO)?
Official (YES / NO) ?
Author:
Revisions:

Not Given
By User
By User
Andre Filiatrault
None

Root Cost Multiplier: 100
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B2011.121

Line 293

NISTIR Name
Description

Exterior Wall - Light framed wood walls with structural panel sheathing, gypsum wallboard and hold-downs
Costing for each 100 ft^2 Wall Panel. Assumed framing: 1 SIDE: 3/8" OSB or 15/32 ply with 8d box nails at 4 to 6 inches along panel edges and 12 inches field nailing, DF #2, 2x4@16 studs. 1 SIDE: 1/2 gypsum board. Panel 8 feet tall, 8 or 16 feet long with or without door and window openings, double top plate, single bottom plate, with hold-downs.

Construction Quality:	Not Specified				
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	SF 100		Quantity Rounding Round Qty? NO		
Demand Parameter (unit):	Story Drift Ratio		Allow sum by floor or building? NO		
Number of Damage States:	3		Demand Location (floor above?) No		
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Slight separation of sheathing or nails which come loose.	Permanent rotation of sheathing, tear out of nails or sheathing.	Fracture of studs, major sill plate cracking.		

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, δ :	0.015	0.0262	0.0369		
Data dispersion, β_d :	0.26	0.16	0.17		
Uncertainty, β_u :	0.3	0.1	0.1		
Total Dispersion, β :	0.4	0.19	0.2		
Correlation (Yes / No)	NO	Data Quality Superior	Documentation Quality Superior		
Directionality (Yes / No)	YES	Data Relevance Superior	Rationality Superior		

Consequence Functions
Repair Description

Remove exterior pliable siding, replace loose nails, reinstall siding.
Remove exterior pliable siding, remove wood sheathing, install new sheathing, reinstall siding.
Remove and replace siding, sheathing, studs and plates. Provide shoring as required.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.38E+03	1.64E+03	2.19E+03	1.71E+03	2.14E+03	2.93E+03	5.19E+03	5.38E+03	6.31E+03						
Best fit mean:	1.70E+03			2.20E+03			5.61E+03								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00 8.00			3.00 8.00			3.00 8.00								
Average Repair Cost (Min Qty, Max Qty)	2.13E+03 1.31E+03			2.57E+03 1.82E+03			6.45E+03 4.57E+03								
CV or beta (Min Qty, Max Qty)	0.19 0.19			0.22 0.22			0.08 0.08								
Quantity Unit:	100 ft^2 Units			100 ft^2 Units			100 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.07E+00	1.28E+00	1.71E+00	1.33E+00	1.67E+00	2.28E+00	4.05E+00	4.19E+00	4.92E+00						
Best fit mean:	1.28E+00			1.67E+00			4.19E+00								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00 8.00			3.00 8.00			3.00 8.00								
Average Repair Time (Min Qty, Max Qty)	1.66E+00 1.02E+00			2.00E+00 1.42E+00			5.03E+00 3.56E+00								
CV or beta (Min Qty, Max Qty)	0.31 0.31			0.33 0.33			0.26 0.26								
Quantity Unit:	100 ft^2 Units			100 ft^2 Units			100 ft^2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.4E+03	LogNormal	0.31	2.0E+03	LogNormal	0.33	3.0E+03	LogNormal	0.26						
Embodied Energy (MJ)	2.4E+04	LogNormal	0.31	2.1E+04	LogNormal	0.33	3.9E+04	LogNormal	0.26						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			50% 0.50			25% 0.50								

Comments: Copy of B1071.021 for use as an exterior wall.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Andre Filiatrault
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.

Root Cost Multiplier: 100
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B2011.131

Line 294

NISTIR Name
Description

Exterior Wall - Wood walls with diagonal let-in bracing
Costing for each 100 ft^2 Wall Panel. Assumed framing: Stud wall framing consists of 2 x 4's at 16 inches on center with double top plates and single sill plate. Diagonal bracing includes 2 forms. Block-bracing consists of diagonal blocking between studs that extends from the top of one edge of the panel to the bottom of the opposite edge. Diagonal bracing may also consist of let-in bracing for which a 1x or 2x brace (with same inclination as described for block-bracing) is recessed into studs. Walls may be sheathed with horizontal or vertical lumber siding.

Construction Quality:
Seismic Installation Conditions:

Not Specified
Not Specified

Fragility Unit of Measure:
Demand Parameter (unit):

SF 100
Story Drift Ratio

Quantity Rounding Round Qty? NO
Allow sum by floor or building? NO
Demand Location (floor above?) NO

Number of Damage States: 1
Damage State: DS1

Type of Damage State: Sequential
DS Hierarchy: Seq(DS1)
Descriptions: Failure of diagonal bracing.

Illustrations



Damage State Probability:

1.00

Fragility Parameters

Median Demand, θ :
Data dispersion, β_d :
Uncertainty, β_u :
Total Dispersion, β :

0.01
Not Specified
0.4
0.4

Correlation (Yes / No)
Directionality (Yes / No)

NO
YES

Data Quality Average
Data Relevance Average

Documentation Quality Superior
Rationality Superior

Consequence Functions
Repair Description

Remove and replace sheathing studs, plates and bracing and replace with new stud wall construction of plywood, hold-downs, etc. Provide shoring as required.

Long Lead Time (Yes / No)

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	4.01E+03	4.74E+03	5.27E+03												
Best fit mean:	4.68E+03														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	4.00		11.00												
Average Repair Cost (Min Qty, Max Qty)	6.16E+03		3.79E+03												
CV or beta (Min Qty, Max Qty)	0.11		0.11												
Quantity Unit:	100 ft^2 Units														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	3.13E+00	3.70E+00	4.11E+00												
Best fit mean:	3.70E+00														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	4.00		11.00												
Average Repair Time (Min Qty, Max Qty)	4.81E+00		2.96E+00												
CV or beta (Min Qty, Max Qty)	0.27		0.27												
Quantity Unit:	100 ft^2 Units														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.2E+03		0.27												
Embodied Energy (MJ)	3.0E+04		0.27												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%		0.00												
Loss of Life (Median, Dispersion)	0%		0.00												
Post-event Tagging Flag:	YES														
Unsafe Placard Trigger (Median, Dispersion)	25%		0.50												

Comments:

Copy of B1071.031 for use as an exterior wall.

Date Created:
Approved (YES / NO)?
Official (YES / NO) ?
Author:
Revisions:

Not Given
By User
By User
Andre Filiatrault
None

Root Cost Multiplier: 100
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification B2011.201a
NISTIR Name Precast Concrete Panels 4.5 inches thick - in plane deformation
Description Costing is based upon 30"x13" panels.

Line 295

Construction Quality:	Not Specified					<div>Quantity RoundingRound Qty? NO Allow sum by floor or building? NO Demand Location (floor above?) No</div>
Seismic Installation Conditions:	All					
Fragility Unit of Measure:	LF 30					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Mutually Exclusive		Mutually Exclusive			
DS Hierarchy	MutEx(DS1,DS2)					
Descriptions	Cladding units damaged by impact at corners at column covers. Damage in field is either attributed to natural edge chipping / damage, or is deemed to not warrant full repair. Repair assumes cosmetic chip patching.		Cladding units damaged by impact at corners at column covers.			

Illustrations					
	none	none			
	0.50	0.50			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	By User	By User			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	By User	By User			
Correlation (Yes / No)	NO	Data Quality By User		Documentation Quality By User	
Directionality (Yes / No)	YES	Data Relevance By User		Rationality By User	

Consequence Functions
Repair Description By User, Repair cost assumed to equal 20% of DS2. By User, Cost listed assumed the replacement of the panel

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	8.33E+03	1.27E+04	1.42E+04	4.17E+04	6.34E+04	7.09E+04									
Best fit mean:	1.17E+04			5.86E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	2.00		8.00	2.00		8.00									
Average Repair Cost (Min Qty, Max Qty)	1.65E+04		1.01E+04	8.24E+04		5.07E+04									
CV or beta (Min Qty, Max Qty)	0.19		0.19	0.19		0.19									
Quantity Unit:	390 ft² Units			390 ft² Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.22E+00	1.86E+00	2.08E+00	6.12E+00	9.32E+00	1.04E+01									
Best fit mean:	1.72E+00			8.62E+00											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	2.00		8.00	2.00		8.00									
Average Repair Time (Min Qty, Max Qty)	2.42E+00		1.49E+00	1.21E+01		7.46E+00									
CV or beta (Min Qty, Max Qty)	0.32		0.32	0.32		0.32									
Quantity Unit:	390 ft² Units			390 ft² Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.2E+04	Normal	0.32	5.8E+04	Normal	0.32									
Embodied Energy (MJ)	1.6E+05	Normal	0.32	8.2E+05	Normal	0.32									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										

Comments: Determine fragility story drift median demand in accordance with Chapter 7 of Volume 2.
Date Created: By User
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: By User
Revisions: 2016-06-27 Revise DS1 to be MutEx reduced cost version of itself.
Root Cost Multiplier: 390
Date Generated: 02/26/19

Root Cost Multiplier: 390
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2022.001

Curtain Walls - Generic Midrise Stick-Built Curtain wall, Config: Monolithic, Lamination: Unknown, Glass Type: Unknown, Details: Aspect ratio = 6:5, Other details Unkno

Line 297

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

SF 30

Story Drift Ratio

2

DS1

Sequential

Seq(DS1,DS2)

Glass cracking.

DS2

Sequential

Glass falls from frame.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations



Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Consequence Functions

Repair Description

1.00

0.0338

0.0797

0.25

0.4

NO

YES

Replace cracked glass panel.

1.00

0.0383

0.19

0.25

0.4

Replace cracked glass panel; cover exposure in meantime.

Data Quality

Data Relevance

Superior

Average

Documentation Quality

Rationality

Superior

Superior

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.37E+03	1.37E+03	2.00E+03	1.37E+03	1.37E+03	2.00E+03									
Best fit mean:	1.55E+03			1.55E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	20.00 100.00			20.00 100.00											
Average Repair Cost (Min Qty, Max Qty)	2.06E+03 1.10E+03			2.06E+03 1.10E+03											
CV or beta (Min Qty, Max Qty)	0.17 0.17			0.17 0.17											
Quantity Unit:	Each (5'x6' Panel)			Each (5'x6' Panel)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	6.03E-01	6.03E-01	8.82E-01	6.03E-01	6.03E-01	8.82E-01									
Best fit mean:	6.03E-01			6.03E-01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	20.00 100.00			20.00 100.00											
Average Repair Time (Min Qty, Max Qty)	9.05E-01 4.82E-01			9.05E-01 4.82E-01											
CV or beta (Min Qty, Max Qty)	0.30 0.30			0.30 0.30											
Quantity Unit:	Each (5'x6' Panel)			Each (5'x6' Panel)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.1E+02	LogNormal	0.30	4.1E+02	LogNormal	0.30									
Embodied Energy (MJ)	9.4E+03	LogNormal	0.30	9.4E+03	LogNormal	0.30									
LifeSafety Hazard:	NO			YES											
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			36 SF											
Serious Injury (Median, Dispersion)	0% 0.00			2% 0.50											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			90% 0.50											

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

By User

By User

By User

Not Given

2011-08-24 Negative probability below 0.5% drift - Overlap deemed acceptable.

Root Cost Multiplier:

Date Generated:

30

02/26/19

Root Cost Multiplier: 30
Date Generated: 02/26/19

Root Cost Multiplier: 30
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2022.021

Midrise stick-built curtain wall, Config: Monolithic, Lamination: Laminated, Glass Type: Annealed, Details: 1/4 in. (6 mm) AN LAM (0.030 PVB); glass-frame clearance = 0.

None

Line 300

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

SF 30

Story Drift Ratio

2

DS1

Sequential

Seq(DS1,DS2)

Glass cracking.

DS2

Sequential

Glass falls from frame.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations



Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Consequence Functions

Repair Description

1.00

0.0156

0.2353

0.25

0.35

NO

YES

Replace cracked glass panel.

1.00

0.0561

0.19

0.25

0.3

Data Quality Superior

Data Relevance Average

Replace cracked glass panel; cover exposure in meantime.

Documentation Quality Superior

Rationality Superior

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.97E+03	1.97E+03	2.60E+03	1.97E+03	1.97E+03	2.60E+03									
Best fit mean:	2.16E+03			2.16E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	20.00 100.00			20.00 100.00											
Average Repair Cost (Min Qty, Max Qty)	2.96E+03 1.58E+03			2.96E+03 1.58E+03											
CV or beta (Min Qty, Max Qty)	0.12 0.12			0.12 0.12											
Quantity Unit:	Each (5'x6' Panel)			Each (5'x6' Panel)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.70E-01	8.70E-01	1.15E+00	8.70E-01	8.70E-01	1.15E+00									
Best fit mean:	8.70E-01			8.70E-01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	20.00 100.00			20.00 100.00											
Average Repair Time (Min Qty, Max Qty)	1.30E+00 6.96E-01			1.30E+00 6.96E-01											
CV or beta (Min Qty, Max Qty)	0.28 0.28			0.28 0.28											
Quantity Unit:	Each (5'x6' Panel)			Each (5'x6' Panel)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.0E+03	LogNormal	0.28	1.0E+03	LogNormal	0.28									
Embodied Energy (MJ)	2.4E+04	LogNormal	0.28	2.4E+04	LogNormal	0.28									
LifeSafety Hazard:	NO			YES											
Potential non-collapse casualties? (Yes / No)	NO			YES											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			36 SF											
Serious Injury (Median, Dispersion)	0% 0.00			2% 0.50											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			90% 0.50											

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

By User

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

30

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2022.022

Midrise stick-built curtain wall, Config: Monolithic, Lamination: Laminated, Glass Type: Annealed, Details: 1/4 in. (6 mm) AN laminated, 2-sided SSG, Center Panel; glass-l

None

Line 301

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

SF 30

Story Drift Ratio

2

DS1

Sequential

Seq(DS1,DS2)

Glass cracking.

Not Specified

DS2

Sequential

Not Specified

Glass falls from frame.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

none

1.00

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.0392

Not Specified

Not Specified

0.29

NO

YES

0.0434

Not Specified

Not Specified

0.25

Data Quality Not Rated

Data Relevance Not Rated

Documentation Quality Not Rated

Rationality Not Rated

Consequence Functions

Repair Description

Replace cracked glass panel.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.37E+03

1.37E+03

2.00E+03

LogNormal

20.00

100.00

2.06E+03

1.10E+03

0.17

0.17

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

1.37E+03

1.37E+03

2.00E+03

LogNormal

20.00

100.00

2.06E+03

1.10E+03

0.17

0.17

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

6.03E-01

6.03E-01

8.82E-01

LogNormal

20.00

100.00

9.05E-01

4.82E-01

0.30

0.30

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

6.03E-01

6.03E-01

8.82E-01

LogNormal

20.00

100.00

9.05E-01

4.82E-01

0.30

0.30

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

4.1E+02

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

4.1E+02

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

By User

0%

0.00

NO

0%

0.00

YES

36 SF

2%

0.50

YES

90%

0.50

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent actual consequence.

By User

By User

By User

Not Given

None

Root Cost Multiplier: 30

Date Generated: 02/26/19

Comments:	confirm damage state, repair, lead time, and casualty data. This component requires user specified cost and time consequence data. Values within PACT are defaults		
Date Created:	By User	Root Cost Multiplier:	30
Approved (YES / NO)?	By User	Date Generated:	02/26/19
Official (YES / NO) ?	By User		
Author:	By User		
Revisions:	None		

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2022.031

Midrise stick-built curtain wall, Config: Monolithic, Lamination: Not laminated, Glass Type: Annealed, Details: 1/4 in. (6 mm) AN monolithic; glass-frame clearance = 0.43

None

Line 303

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

SF 30

Story Drift Ratio

2

DS1

Sequential

Seq(DS1,DS2)

Glass cracking.

Not Specified

Not Specified

Unit less

DS2

Sequential

Glass falls from frame.

Quantity Rounding

Round Qty?

NO

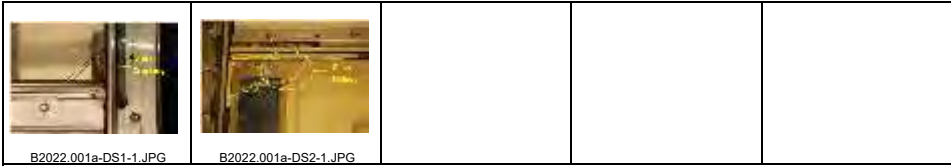
Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations



Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Consequence Functions

Repair Description

1.00

0.0138

0.0797

0.25

0.25

NO

YES

Replace cracked glass panel.

1.00

0.0219

0.19

0.25

0.3

Replace cracked glass panel; cover exposure in meantime.

Data Quality

Data Relevance

Superior

Average

Documentation Quality

Rationality

Superior

Superior

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.37E+03	1.37E+03	2.00E+03	1.37E+03	1.37E+03	2.00E+03									
Best fit mean:	1.55E+03			1.55E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	20.00 100.00			20.00 100.00											
Average Repair Cost (Min Qty, Max Qty)	2.06E+03 1.10E+03			2.06E+03 1.10E+03											
CV or beta (Min Qty, Max Qty)	0.17 0.17			0.17 0.17											
Quantity Unit:	Each (5'x6' Panel)			Each (5'x6' Panel)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	6.03E-01	6.03E-01	8.82E-01	6.03E-01	6.03E-01	8.82E-01									
Best fit mean:	6.03E-01			6.03E-01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	20.00 100.00			20.00 100.00											
Average Repair Time (Min Qty, Max Qty)	9.05E-01 4.82E-01			9.05E-01 4.82E-01											
CV or beta (Min Qty, Max Qty)	0.30 0.30			0.30 0.30											
Quantity Unit:	Each (5'x6' Panel)			Each (5'x6' Panel)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	4.1E+02	LogNormal	0.30	4.1E+02	LogNormal	0.30									
Embodied Energy (MJ)	9.4E+03	LogNormal	0.30	9.4E+03	LogNormal	0.30									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			YES											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			36 SF											
Serious Injury (Median, Dispersion)	0% 0.00			2% 0.50											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			90% 0.50											

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

By User

By User

By User

Not Given

2011-08-24 Negative probability below 0.5% drift - Overlap deemed acceptable.

Root Cost Multiplier:

Date Generated:

30

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2022.032

Midrise stick-built curtain wall, Config: Monolithic, Lamination: Not laminated, Glass Type: Annealed, Details: 1/4 in. (6 mm) AN monolithic; glass-frame clearance = 0 in.

None

Line 304

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

SF 30

Story Drift Ratio

2

DS1

Sequential

Seq(DS1,DS2)

Glass cracking.

DS2

Sequential

Glass falls from frame.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations



Damage State Probability:

Fragility Parameters

Median Demand, δ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Consequence Functions

Repair Description

1.00

0.0088

0.0321

0.25

0.25

NO

YES

Replace cracked glass panel.

1.00

0.0108

0.03

0.25

0.25

Replace cracked glass panel; cover exposure in meantime.

Data Quality

Data Relevance

Superior

Average

Documentation Quality

Rationality

Superior

Superior

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.37E+03	1.37E+03	2.00E+03	1.37E+03	1.37E+03	2.00E+03									
Best fit mean:	1.55E+03			1.55E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	20.00 100.00			20.00 100.00											
Average Repair Cost (Min Qty, Max Qty)	2.06E+03 1.10E+03			2.06E+03 1.10E+03											
CV or beta (Min Qty, Max Qty)	0.17 0.17			0.17 0.17											
Quantity Unit:	Each (5'x6' Panel)			Each (5'x6' Panel)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	6.03E-01	6.03E-01	8.82E-01	6.03E-01	6.03E-01	8.82E-01									
Best fit mean:	6.03E-01			6.03E-01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	20.00 100.00			20.00 100.00											
Average Repair Time (Min Qty, Max Qty)	9.05E-01 4.82E-01			9.05E-01 4.82E-01											
CV or beta (Min Qty, Max Qty)	0.30 0.30			0.30 0.30											
Quantity Unit:	Each (5'x6' Panel)			Each (5'x6' Panel)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.1E+02	LogNormal	0.30	4.1E+02	LogNormal	0.30									
Embodied Energy (MJ)	9.4E+03	LogNormal	0.30	9.4E+03	LogNormal	0.30									
LifeSafety Hazard:	NO			YES											
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			36 SF											
Serious Injury (Median, Dispersion)	0% 0.00			2% 0.50											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			90% 0.50											

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

By User

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

30

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2022.033

Midrise stick-built curtain wall, Config: Monolithic, Lamination: Not laminated, Glass Type: Annealed, Details: 1/4 in. (6 mm) AN monolithic; glass-frame clearance = 0.13

None

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

SF 30

Story Drift Ratio

2

DS1

Sequential

Seq(DS1,DS2)

Glass cracking.

DS2

Sequential

Glass falls from frame.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

B2022.001a-DS1-1.JPG

1.00

B2022.001a-DS2-1.JPG

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.0084

0.0757

0.25

0.25

NO

YES

Data Quality

Data Relevance

Superior

Average

Documentation Quality

Rationality

Superior

Superior

Consequence Functions

Repair Description

Replace cracked glass panel.

Replace cracked glass panel; cover exposure in meantime.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.97E+03

1.97E+03

2.60E+03

2.16E+03

LogNormal

20.00

100.00

2.96E+03

1.58E+03

0.12

0.12

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

1.97E+03

1.97E+03

2.60E+03

2.16E+03

LogNormal

20.00

100.00

2.96E+03

1.58E+03

0.12

0.12

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

8.70E-01

8.70E-01

1.15E+00

8.70E-01

LogNormal

20.00

100.00

1.30E+00

6.96E-01

0.28

0.28

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

8.70E-01

8.70E-01

1.15E+00

8.70E-01

LogNormal

20.00

100.00

1.30E+00

6.96E-01

0.28

0.28

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

4.1E+02

LogNormal

0.28

4.1E+02

LogNormal

0.28

Median Cost

Best Fit

CV or Beta

4.1E+02

LogNormal

0.28

4.1E+02

LogNormal

0.28

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

NO

0%

0.00

YES

36 SF

2%

0.50

YES

90%

0.50

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

By User

By User

By User

Not Given

2011-08-24 Negative probability below 0.5% drift - Overlap deemed acceptable.

Root Cost Multiplier:

Date Generated:

30

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2022.034

Midrise stick-built curtain wall, Config: Monolithic, Lamination: Not laminated, Glass Type: Annealed, Details: 1/4 in. (6 mm) AN monolithic; glass-frame clearance = 0.25

Line 306

Construction Quality:		Not Specified			<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>
Seismic Installation Conditions:		Not Specified			
Fragility Unit of Measure:		SF 30			
Demand Parameter (unit):		Story Drift RatioUnit less			
Number of Damage States:		2			
Damage State:		DS1		DS2	
Type of Damage State:		Sequential		Sequential	
DS Hierarchy		Seq(DS1,DS2)			
Descriptions		Glass cracking.		Glass falls from frame.	

Illustrations



B2022.001a-DS1-1.JPG



B2022.001a-DS2-1.JPG

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

1.00

0.0147

0.0299

0.25

0.25

1.00

0.0164

0.08

0.25

0.25

Correlation (Yes / No)

YES

Data Quality Superior

Documentation Quality Superior

Directionality (Yes / No)

YES

Data Relevance Average

Rationality Superior

Consequence Functions

Repair Description

Replace cracked glass panel.

Replace cracked glass panel; cover exposure in meantime.

Long Lead Time (Yes / No)	NO			NO											
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.97E+03	1.97E+03	2.60E+03	1.97E+03	1.97E+03	2.60E+03									
Best fit mean:	2.16E+03			2.16E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	20.00		100.00	20.00		100.00									
Average Repair Cost (Min Qty, Max Qty)	2.96E+03		1.58E+03	2.96E+03		1.58E+03									
CV or beta (Min Qty, Max Qty)	0.12		0.12	0.12		0.12									
Quantity Unit:	Each (5'x6' Panel)			Each (5'x6' Panel)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.70E-01	8.70E-01	1.15E+00	8.70E-01	8.70E-01	1.15E+00									
Best fit mean:	8.70E-01			8.70E-01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	20.00		100.00	20.00		100.00									
Average Repair Time (Min Qty, Max Qty)	1.30E+00		6.96E-01	1.30E+00		6.96E-01									
CV or beta (Min Qty, Max Qty)	0.28		0.28	0.28		0.28									
Quantity Unit:	Each (5'x6' Panel)			Each (5'x6' Panel)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.1E+02	LogNormal	0.28	4.1E+02	LogNormal	0.28									
Embodied Energy (MJ)	9.4E+03	LogNormal	0.28	9.4E+03	LogNormal	0.28									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			YES											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			36 SF											
Serious Injury (Median, Dispersion)	0%		0.00	2%		0.50									
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00									
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00	90%		0.50									

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

By User

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

30

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2022.035

Midrise stick-built curtain wall, Config: Monolithic, Lamination: Not laminated, Glass Type: Annealed, Details: 1/4 in. (6 mm) AN monolithic; glass-frame clearance = 0.43

None

Line 307

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

SF 32

Story Drift Ratio

2

DS1

Sequential

Seq(DS1,DS2)

Glass cracking.

Not Specified

DS2

Sequential

Glass falls from frame.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

B2022.001a-DS1-1.JPG

B2022.001a-DS2-1.JPG

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Consequence Functions

Repair Description

1.00

1.00

0.0181

0.0782

0.25

0.25

0.0212

User to Calculate

0.25

0.25

NO

YES

Data Quality Superior

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Replace cracked glass panel.

Replace cracked glass panel; cover exposure in meantime.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Time:

Environmental Impacts:

LifeSafety Hazard:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Each (4'x8' Panel)

Each (4'x8' Panel)

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Each (4'x8' Panel)

Each (4'x8' Panel)

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

By User

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

48

02/26/19

Root Cost Multiplier: 48
Date Generated: 02/26/19

B2022.037

Line 309

Midrise stick-built curtain wall, Config: Monolithic, Lamination: Not laminated, Glass Type: Annealed, Details: 1/4 in. (6 mm) AN monolithic, 2-sided SSG, Center Panel; g
None

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Fragility Unit of Measure:		SF 30		Allow sum by floor or building? NO Demand Location (floor above)? No	
Demand Parameter (unit):		Story Drift Ratio Unit less			
Number of Damage States:		2			
Damage State:		DS1		DS2	
Type of Damage State:		Sequential		Sequential	
DS Hierarchy		Seq(DS1,DS2)			
Descriptions		Glass cracking.		Glass falls from frame.	

Illustrations

none	none			
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Damage State Probability:

Fragility Parameters		0.0288	0.04		
Median Demand, θ :		0.0288	0.04		
Data dispersion, β_d :	Not Specified		Not Specified		
Uncertainty, β_u :	Not Specified		Not Specified		
Total Dispersion, δ :	0.26		0.6		

Correlation (Yes / No)	NO	Data Quality	Not Rated	Documentation Quality	Not Rated
Directionality (Yes / No)	YES	Data Relevance	Not Rated	Rationality	Not Rated

Consequence Functions

Repair Description

Replace cracked glass panel.	Replace cracked glass panel; cover exposure in meantime.
------------------------------	--

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.97E+03	1.97E+03	2.60E+03	1.97E+03	1.97E+03	2.60E+03									
Best fit mean:	2.16E+03			2.16E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	20.00 100.00			20.00 100.00											
Average Repair Cost (Min Qty, Max Qty)	2.96E+03 1.58E+03			2.96E+03 1.58E+03											
Quantity Unit:	0.12 Each (5'x6' Panel)			0.12 Each (5'x6' Panel)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.70E-01	8.70E-01	1.15E+00	8.70E-01	8.70E-01	1.15E+00									
Best fit mean:	8.70E-01			8.70E-01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	20.00 100.00			20.00 100.00											
Average Repair Time (Min Qty, Max Qty)	1.30E+00 6.96E-01			1.30E+00 6.96E-01											
CV or beta (Min Qty, Max Qty)	0.28 0.28			0.28 0.28											
Quantity Unit:	Each (5'x6' Panel)			Each (5'x6' Panel)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.1E+02	LogNormal	0.28	4.1E+02	LogNormal	0.28									
Embodied Energy (MJ)	9.4E+03	LogNormal	0.28	9.4E+03	LogNormal	0.28									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			YES											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			36 SF											
Serious Injury (Median, Dispersion)	0% 0.00			2% 0.50											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			90% 0.50											

Comments:	None
Date Created:	By User
Approved (YES / NO)?	By User
Official (YES / NO) ?	By User
Author:	By User
Revisions:	2018-02-12 Added damage state data

Root Cost Multiplier: 30
Date Generated: 02/26/19

Root Cost Multiplier: 30
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2022.041

Midrise stick-built curtain wall, Config: Monolithic, Lamination: Not laminated, Glass Type: Annealed, Details: 1/4 in. (6 mm) AN monolithic; glass-frame clearance = 0.43

None

Line 313

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

SF 30

Story Drift Ratio

2

DS1

Sequential

Seq(DS1,DS2)

Glass cracking.

Not Specified

DS2

Sequential

Not Specified

Glass falls from frame.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

none

1.00

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.024

Not Specified

Not Specified

0.25

0.027

Not Specified

Not Specified

0.32

Data Quality

Not Rated

Documentation Quality

Not Rated

Data Relevance

Not Rated

Rationality

Not Rated

Consequence Functions

Repair Description

Replace cracked glass panel.

Replace cracked glass panel; cover exposure in meantime.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.97E+03

1.97E+03

2.60E+03

2.16E+03

LogNormal

20.00

100.00

2.96E+03

1.58E+03

0.12

0.12

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

1.97E+03

1.97E+03

2.60E+03

2.16E+03

LogNormal

20.00

100.00

2.96E+03

1.58E+03

0.12

0.12

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

8.70E-01

8.70E-01

1.15E+00

8.70E-01

LogNormal

20.00

100.00

1.30E+00

6.96E-01

0.28

0.28

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

8.70E-01

8.70E-01

1.15E+00

8.70E-01

LogNormal

20.00

100.00

1.30E+00

6.96E-01

0.28

0.28

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

4.1E+02

LogNormal

0.28

4.1E+02

LogNormal

0.28

Median Cost

Best Fit

CV or Beta

4.1E+02

LogNormal

0.28

4.1E+02

LogNormal

0.28

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

NO

0%

0.00

YES

36 SF

2%

0.50

YES

90%

0.50

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

By User

By User

By User

By User

2018-02-12 Added damage state data

Root Cost Multiplier:

Date Generated:

30

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2022.051

Midrise stick-built curtain wall, Config: Monolithic, Lamination: Not laminated, Glass Type: Full tempered, Details: 1/4 in. (6 mm) FT monolithic, 2-sided SSG, Center Pane

None

Line 314

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

SF 30

Story Drift Ratio

2

DS1

Sequential

Seq(DS1,DS2)

Glass cracking.

Not Specified

DS2

Sequential

Not Specified

Glass falls from frame.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

none

1.00

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.043

Not Specified

Not Specified

0.25

NO

YES

0.05

Not Specified

Not Specified

0.25

Data Quality

Not Rated

Data Relevance

Not Rated

Documentation Quality

Not Rated

Rationality

Not Rated

Consequence Functions

Repair Description

Replace cracked glass panel.

Replace cracked glass panel; cover exposure in meantime.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.97E+03

1.97E+03

2.60E+03

2.16E+03

LogNormal

20.00

100.00

2.96E+03

1.58E+03

0.12

0.12

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

1.97E+03

1.97E+03

2.60E+03

2.16E+03

LogNormal

20.00

100.00

2.96E+03

1.58E+03

0.12

0.12

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

8.70E-01

8.70E-01

1.15E+00

8.70E-01

LogNormal

20.00

100.00

1.30E+00

6.96E-01

0.28

0.28

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

8.70E-01

8.70E-01

1.15E+00

8.70E-01

LogNormal

20.00

100.00

1.30E+00

6.96E-01

0.28

0.28

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

4.1E+02

LogNormal

0.28

9.4E+03

LogNormal

0.28

Median Cost

Best Fit

CV or Beta

4.1E+02

LogNormal

0.28

9.4E+03

LogNormal

0.28

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

NO

0%

0.00

YES

36 SF

2%

0.50

YES

90%

0.50

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

By User

By User

By User

By User

2018-02-12 Added damage state data

Root Cost Multiplier:

Date Generated:

30

02/26/19

Root Cost Multiplier: 30
Date Generated: 02/26/19

NISTIR Classification

Line 316

Midrise stick-built curtain wall, Config: Monolithic, Lamination: Not laminated, Glass Type: Full tempered, Details: 1/4 in. (6 mm) FT monolithic, Seamed Edge; glass-frame
None

Quantity Rounding	Round Qty?	NO
	Allow sum by floor or building?	NO
	Demand Location (floor above?)	No

Fragility Unit of Measure:		SF 30		Allow sum by floor or building? NO Demand Location (floor above?) No	
Demand Parameter (unit):		Story Drift Ratio Unit less			
Number of Damage States:		2			
Damage State:		DS1		DS2	
Type of Damage State:		Sequential		Sequential	
DS Hierarchy		Seq(DS1_DS2)			
Descriptions		Glass cracking.		Glass falls from frame.	

Illustrations

none	none			
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Damage State Probability:

Frailty Parameters	Fixed	Fixed			
Median Demand, θ :	0.029	0.039			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, δ :	0.3	0.3			

Correlation (Yes / No)	NO	Data Quality	Not Rated	Documentation Quality	Not Rated
Directionality (Yes / No)	YES	Data Relevance	Not Rated	Rationality	Not Rated

Consequence Functions

Consequence Functions	Repair Description	Repair Duration
Replace cracked glass panel.	Replace cracked glass panel; cover exposure in meantime.	10 minutes

Long Lead Time (Yes / No)

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.97E+03	1.97E+03	2.60E+03	1.97E+03	1.97E+03	2.60E+03									
Best fit mean:	2.16E+03			2.16E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	20.00 100.00			20.00 100.00											
Average Repair Cost (Min Qty, Max Qty)	2.96E+03 1.58E+03			2.96E+03 1.58E+03											
CV or beta (Min Qty, Max Qty)	0.12 0.12			0.12 0.12											
Quantity Unit:	Each (5'x6' Panel)			Each (5'x6' Panel)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.70E-01	8.70E-01	1.15E+00	8.70E-01	8.70E-01	1.15E+00									
Best fit mean:	8.70E-01			8.70E-01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	20.00 100.00			20.00 100.00											
Average Repair Time (Min Qty, Max Qty)	1.30E+00 6.96E-01			1.30E+00 6.96E-01											
CV or beta (Min Qty, Max Qty)	0.28 0.28			0.28 0.28											
Quantity Unit:	Each (5'x6' Panel)			Each (5'x6' Panel)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.1E+02	LogNormal	0.28	4.1E+02	LogNormal	0.28									
Embodied Energy (MJ)	9.4E+03	LogNormal	0.28	9.4E+03	LogNormal	0.28									
LifeSafety Hazard:	NO			YES											
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			36 SF											
Serious Injury (Median, Dispersion)	0% 0.00			2% 0.50											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			90% 0.50											

Comments:	None
Date Created:	By User
Approved (YES / NO)?	By User
Official (YES / NO) ?	By User
Author:	By User
Revisions:	2018-02-12 Added damage state data

Root Cost Multiplier: 30
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2022.054

Midrise stick-built curtain wall, Config: Monolithic, Lamination: Not laminated, Glass Type: Full tempered, Details: 1/4 in. (6 mm) FT monolithic, Polished Edge; glass-fran

None

Line 317

Construction Quality:	Not Specified				
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	SF 30				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	2				
Damage State:	DS1		DS2		
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Glass cracking.		Glass falls from frame.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	No	

Illustrations					
	none	none			
	1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.033		0.043		
Data dispersion, β_d :	Not Specified		Not Specified		
Uncertainty, β_u :	Not Specified		Not Specified		
Total Dispersion, β :	0.25		0.25		
Correlation (Yes / No)	NO		Data Quality Not Rated		Documentation Quality Not Rated
Directionality (Yes / No)	YES		Data Relevance Not Rated		Rationality Not Rated

Consequence Functions					
Repair Description	Replace cracked glass panel.		Replace cracked glass panel; cover exposure in meantime.		

Long Lead Time (Yes / No)NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.97E+03	1.97E+03	2.60E+03	1.97E+03	1.97E+03	2.60E+03									
Best fit mean:	2.16E+03			2.16E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	20.00		100.00	20.00		100.00									
Average Repair Cost (Min Qty, Max Qty)	2.96E+03		1.58E+03	2.96E+03		1.58E+03									
CV or beta (Min Qty, Max Qty)	0.12		0.12	0.12		0.12									
Quantity Unit:	Each (5'x6' Panel)			Each (5'x6' Panel)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.70E-01	8.70E-01	1.15E+00	8.70E-01	8.70E-01	1.15E+00									
Best fit mean:	8.70E-01			8.70E-01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	20.00		100.00	20.00		100.00									
Average Repair Time (Min Qty, Max Qty)	1.30E+00		6.96E-01	1.30E+00		6.96E-01									
CV or beta (Min Qty, Max Qty)	0.28		0.28	0.28		0.28									
Quantity Unit:	Each (5'x6' Panel)			Each (5'x6' Panel)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.1E+02	LogNormal	0.28	4.1E+02	LogNormal	0.28									
Embodied Energy (MJ)	9.4E+03	LogNormal	0.28	9.4E+03	LogNormal	0.28									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			YES											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			36 SF											
Serious Injury (Median, Dispersion)	0%		0.00	2%		0.50									
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00									
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00	90%		0.50									

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

By User

By User

By User

By User

2018-02-12 Added damage state data

Root Cost Multiplier:

Date Generated:

30

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification	B2022.071	Line 319
NISTIR Name	Midrise stick-built curtain wall, Config: Symmetric insulating glass units (dual-pane, equal-thickness IGU), Lamination: Laminated, Glass Type: Annealed, Details: 1/4 in. (t	
Description	None	
Construction Quality:	Not Specified	
Seismic Installation Conditions:	Not Specified	
Fragility Unit of Measure:	SF 30	Quantity Rounding Round Qty? NO
Demand Parameter (unit):	Story Drift Ratio	Unit less
Number of Damage States:	3	Allow sum by floor or building? NO
Damage State:	DS1	DS2
Type of Damage State:	Sequential	Sequential
DS Hierarchy	Seq(DS1,DS2,DS3)	Sequential
Descriptions	Gasket seal failure.	Glass cracking.
		Glass falls out.

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.027	0.0276	0.0303		
Data dispersion, β_d :	0.2	0.16	0.1472		
Uncertainty, β_u :	0.25	0.25	0.25		
Total Dispersion, β :	0.3	0.3	0.3		
Correlation (Yes / No)	NO	Data Quality Superior	Documentation Quality Superior		
Directionality (Yes / No)	YES	Data Relevance Average	Rationality Superior		
Consequence Functions					
Repair Description	Remove glass panel and replace damaged gaskets.	Replace cracked glass panel.	Replace cracked glass panel; cover exposure in meantime.		

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.37E+03	1.37E+03	2.00E+03	1.97E+03	1.97E+03	2.60E+03	1.97E+03	1.97E+03	2.60E+03						
Best fit mean:	1.55E+03			2.16E+03			2.16E+03								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	20.00 100.00			20.00 100.00			20.00 100.00								
Average Repair Cost (Min Qty, Max Qty)	2.06E+03 1.10E+03			2.96E+03 1.58E+03			2.36E+03 1.67E+03								
CV or beta (Min Qty, Max Qty)	0.17 0.17			0.12 0.12			0.12 0.12								
Quantity Unit:	Each (5'x6' Panel)			Each (5'x6' Panel)			Each (5'x6' Panel)								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	6.03E-01	6.03E-01	8.82E-01	8.70E-01	8.70E-01	1.15E+00	8.70E-01	8.70E-01	1.15E+00						
Best fit mean:	6.03E-01			8.70E-01			8.70E-01								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	20.00 100.00			20.00 100.00			20.00 100.00								
Average Repair Time (Min Qty, Max Qty)	9.05E-01 4.82E-01			1.30E+00 6.96E-01			1.04E+00 7.40E-01								
CV or beta (Min Qty, Max Qty)	0.30 0.30			0.28 0.28			0.28 0.28								
Quantity Unit:	Each (5'x6' Panel)			Each (5'x6' Panel)			Each (5'x6' Panel)								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.1E+02	LogNormal	0.30	1.0E+03	LogNormal	0.28	1.0E+03	LogNormal	0.28						
Embodied Energy (MJ)	9.4E+03	LogNormal	0.30	2.4E+04	LogNormal	0.28	2.4E+04	LogNormal	0.28						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			YES								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			36 SF								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		2%	0.50							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		90%	0.50							

Comments:	None	Root Cost Multiplier: 30
Date Created:	By User	Date Generated: 02/26/19
Approved (YES / NO)?	By User	
Official (YES / NO) ?	By User	
Author:	Not Given	
Revisions:	None	

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2022.072


Midrise stick-built curtain wall, Config: Symmetric insulating glass units (dual-pane, equal-thickness IGU), Lamination: Laminated, Glass Type: Annealed, Details: 1/4 in. (t

None


Line 320

Construction Quality:	Not Specified					<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	SF 30					
Demand Parameter (unit):	Story Drift RatioUnit less					
Number of Damage States:	3					
Damage State:	DS1	DS2	DS3			
Type of Damage State:	Sequential		Sequential		Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)					
Descriptions	Gasket seal failure.		Glass cracking.		Glass falls out.	


Illustrations



B2022.003-DS1-1.JPG



B2022.001a-DS1-1.JPG



B2022.001a-DS2-1.JPG

Damage State Probability:

1.00	1.00	1.00		
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Fragility Parameters

Median Demand, θ :	0.0262	0.0266	0.0299	
Data dispersion, β_d :	0.1953	0.20	0.2396	
Uncertainty, β_u :	0.25	0.25	0.25	
Total Dispersion, β :	0.3	0.3	0.3	

Correlation (Yes / No)NO

Directionality (Yes / No)YES

Data Quality Superior

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Consequence Functions

Repair Description

Remove glass panel and replace damaged gaskets.

Replace cracked glass panel.

Replace cracked glass panel; cover exposure in meantime.

Long Lead Time (Yes / No)	NO			NO			NO								
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.37E+03	1.37E+03	2.00E+03	1.97E+03	1.97E+03	2.60E+03	1.97E+03	1.97E+03	2.60E+03						
Best fit mean:	1.55E+03			2.16E+03			2.16E+03								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	20.00 100.00			20.00 100.00			20.00 100.00								
Average Repair Cost (Min Qty, Max Qty)	2.06E+03 1.10E+03			2.96E+03 1.58E+03			2.36E+03 1.67E+03								
CV or beta (Min Qty, Max Qty)	0.17 0.17			0.12 0.12			0.12 0.12								
Quantity Unit:	Each (5'x6' Panel)			Each (5'x6' Panel)			Each (5'x6' Panel)								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	6.03E-01	6.03E-01	8.82E-01	8.70E-01	8.70E-01	1.15E+00	8.70E-01	8.70E-01	1.15E+00						
Best fit mean:	6.03E-01			8.70E-01			8.70E-01								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	20.00 100.00			20.00 100.00			20.00 100.00								
Average Repair Time (Min Qty, Max Qty)	9.05E-01 4.82E-01			1.30E+00 6.96E-01			1.04E+00 7.40E-01								
CV or beta (Min Qty, Max Qty)	0.30 0.30			0.28 0.28			0.28 0.28								
Quantity Unit:	Each (5'x6' Panel)			Each (5'x6' Panel)			Each (5'x6' Panel)								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.1E+02	LogNormal	0.30	1.0E+03	LogNormal	0.28	1.0E+03	LogNormal	0.28						
Embodied Energy (MJ)	9.4E+03	LogNormal	0.30	2.4E+04	LogNormal	0.28	2.4E+04	LogNormal	0.28						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			YES								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			36 SF								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			2% 0.50								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			90% 0.50								

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

By User

By User

By User

Not Given

2011-08-24 DS3 beta changed from 0.35 to 0.3 to avoid negative probabilities.

Root Cost Multiplier:

Date Generated:

30

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2022.081

Midrise stick-built curtain wall, Config: Symmetric insulating glass units (dual-pane, equal-thickness IGU), Lamination: Not laminated, Glass Type: Annealed, Details: 1 in.

None

Line 321

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

SF 30

Story Drift Ratio

2

DS1

Sequential

Seq(DS1,DS2)

Glass cracking.

Not Specified

DS2

Sequential

Glass falls from frame.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

B2022.001a-DS1-1.JPG

B2022.001a-DS2-1.JPG

1.00

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

NO

YES

Data Quality

Data Relevance

Superior

Average

Documentation Quality

Rationality

Superior

Superior

Consequence Functions

Repair Description

Replace cracked glass panel.

Replace cracked glass panel; cover exposure in meantime.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.97E+03

1.97E+03

2.60E+03

2.16E+03

LogNormal

20.00

100.00

2.96E+03

1.58E+03

0.12

0.12

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

1.97E+03

1.97E+03

2.60E+03

2.16E+03

LogNormal

20.00

100.00

2.96E+03

1.58E+03

0.12

0.12

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

8.70E-01

8.70E-01

1.15E+00

8.70E-01

LogNormal

20.00

100.00

1.30E+00

6.96E-01

0.28

0.28

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

8.70E-01

8.70E-01

1.15E+00

8.70E-01

LogNormal

20.00

100.00

1.30E+00

6.96E-01

0.28

0.28

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

1.0E+03

LogNormal

0.28

2.4E+04

LogNormal

0.28

Median Cost

Best Fit

CV or Beta

1.0E+03

LogNormal

0.28

2.4E+04

LogNormal

0.28

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

NO

0%

0.00

YES

36 SF

2%

0.50

YES

90%

0.50

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

By User

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

30

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2022.082

Midrise stick-built curtain wall, Config: Symmetric insulating glass units (dual-pane, equal-thickness IGU), Lamination: Not laminated, Glass Type: Annealed, Details: 1 in.

None

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

SF 30

Story Drift Ratio

2

DS1

Sequential

Seq(DS1,DS2)

Glass cracking.

DS2

Sequential

Glass falls from frame.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

B2022.001a-DS1-1.JPG

1.00

B2022.001a-DS2-1.JPG

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Consequence Functions

Repair Description

0.0142

User to Calculate

0.25

0.25

0.0221

User to Calculate

0.25

0.25

NO

YES

Data Quality Superior

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Replace cracked glass panel.

Replace cracked glass panel; cover exposure in meantime.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.97E+03

1.97E+03

2.60E+03

2.16E+03

LogNormal

20.00

100.00

2.96E+03

1.58E+03

0.12

0.12

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

1.97E+03

1.97E+03

2.60E+03

2.16E+03

LogNormal

20.00

100.00

2.96E+03

1.58E+03

0.12

0.12

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

8.70E-01

8.70E-01

1.15E+00

8.70E-01

LogNormal

20.00

100.00

1.30E+00

6.96E-01

0.28

0.28

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

8.70E-01

8.70E-01

1.15E+00

8.70E-01

LogNormal

20.00

100.00

1.30E+00

6.96E-01

0.28

0.28

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

1.0E+03

LogNormal

0.28

2.4E+04

LogNormal

0.28

Median Cost

Best Fit

CV or Beta

1.0E+03

LogNormal

0.28

2.4E+04

LogNormal

0.28

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

NO

0%

0.00

YES

36 SF

2%

0.50

YES

90%

0.50

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

By User

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

30

02/26/19

Comments:	None		
Date Created:	By User	Root Cost Multiplier:	30
Approved (YES / NO)?	By User	Date Generated:	02/26/19
Official (YES / NO) ?	By User		
Author:	By User		
Revisions:	None		

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2022.084

Midrise stick-built curtain wall, Config: Symmetric insulating glass units (dual-pane, equal-thickness IGU), Lamination: Not laminated, Glass Type: Annealed, Details: 1 in.

None

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

SF 30

Story Drift Ratio

3

DS1

Sequential

Seq(DS1,DS2,DS3)

Gasket seal failure.

DS2

Sequential

Not Specified

Glass cracking.

DS3

Sequential

Not Specified

Glass falls out.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

Damage State Probability:

Correlation (Yes / No)

Directionality (Yes / No)

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Damage State Probability:

1.00

1.00

1.00

0.026

Not Specified

Not Specified

0.11

0.051

Not Specified

Not Specified

0.25

0.054

Not Specified

Not Specified

0.25

NO

YES

Data Quality

Not Rated

Documentation Quality

Not Rated

Rationality

Not Rated

Consequence Functions

Repair Description

Remove glass panel and replace damaged gaskets.

Replace cracked glass panel.

Replace cracked glass panel; cover exposure in meantime.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Time:

Environmental Impacts:

LifeSafety Hazard:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Each (5'x6' Panel)

Each (5'x6' Panel)

Each (5'x6' Panel)

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Each (5'x6' Panel)

Each (5'x6' Panel)

Each (5'x6' Panel)

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

By User

By User

By User

By User

2018-02-12 Added damage state data

Root Cost Multiplier: 30

Date Generated: 02/26/19

Root Cost Multiplier: 30
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2022.101

Midrise stick-built curtain wall, Config: Symmetric insulating glass units (dual-pane, equal-thickness IGU), Lamination: Not laminated, Glass Type: Heat strengthened, Det

None

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

SF 30

Story Drift Ratio

3

DS1

Sequential

Seq(DS1,DS2,DS3)

Gasket seal failure.

DS2

Sequential

Glass cracking.

DS3

Sequential

Glass falls out.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

none

1.00

none

1.00

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

NO

YES

Data Quality

Not Rated

Documentation Quality

Not Rated

Rationality

Not Rated

Consequence Functions

Repair Description

Remove glass panel and replace damaged gaskets.

Replace cracked glass panel.

Replace cracked glass panel; cover exposure in meantime.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.37E+03

1.37E+03

2.00E+03

1.97E+03

1.97E+03

2.60E+03

1.97E+03

1.97E+03

2.60E+03

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.55E+03

LogNormal

20.00

100.00

2.06E+03

1.10E+03

0.17

0.17

Each (5'x6' Panel)

2.16E+03

LogNormal

20.00

100.00

2.96E+03

1.58E+03

0.12

0.12

Each (5'x6' Panel)

2.16E+03

LogNormal

20.00

100.00

2.36E+03

1.67E+03

0.12

0.12

Each (5'x6' Panel)

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

6.03E-01

6.03E-01

8.82E-01

8.70E-01

8.70E-01

1.15E+00

8.70E-01

8.70E-01

1.15E+00

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

6.03E-01

LogNormal

20.00

100.00

9.05E-01

4.82E-01

0.30

0.30

Each (5'x6' Panel)

8.70E-01

LogNormal

20.00

100.00

1.30E+00

6.96E-01

0.28

0.28

Each (5'x6' Panel)

8.70E-01

LogNormal

20.00

100.00

1.04E+00

7.40E-01

0.28

0.28

Each (5'x6' Panel)

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

4.1E+02

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

1.0E+03

LogNormal

0.28

Median Cost

Best Fit

CV or Beta

1.0E+03

LogNormal

0.28

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

2.4E+04

LogNormal

0.28

2.4E+04

LogNormal

0.28

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

YES

36 SF

2%

0.50

0%

0.00

YES

90%

0.50

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

By User

By User

By User

By User

2018-02-12 Added damage state data

Root Cost Multiplier:

30

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2022.201

Curtain Walls - Unitized curtain wall (also generic unitized curtain wall), Config: Symmetric insulating glass units (dual-pane, equal-thickness IGU), Lamination: Not laminated

None

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

SF 30

Story Drift Ratio

3

DS1

Sequential

Seq(DS1,DS2,DS3)

Gasket seal failure.

DS2

Sequential

Not Specified

Glass cracking.

DS3

Sequential

Not Specified

Glass falls out.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

none

none

none

Damage State Probability:

Correlation (Yes / No)

Directionality (Yes / No)

Consequence Functions

Repair Description

1.00

1.00

1.00

NO

YES

Remove glass panel and replace damaged gaskets.

Data Quality

Data Relevance

Not Rated

Not Rated

Documentation Quality

Rationality

Not Rated

Not Rated

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

0.026

0.05

0.1

0.45

Not Specified

Not Specified

Not Specified

Not Specified

0.17

0.12

0.12

0.12

Each (5'x6' Panel)

Each (5'x6' Panel)

Each (5'x6' Panel)

Each (5'x6' Panel)

Long Lead Time (Yes / No)

Repair Costs:

Repair Time:

Environmental Impacts:

LifeSafety Hazard:

NO

NO

NO

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

1.37E+03

1.37E+03

2.00E+03

1.97E+03

1.97E+03

2.60E+03

1.97E+03

1.97E+03

2.60E+03

1.0E+03

LogNormal

0.28

1.0E+03

LogNormal

0.28

2.4E+04

LogNormal

0.28

1.55E+03

2.16E+03

2.16E+03

1.0E+03

LogNormal

0.30

1.0E+03

LogNormal

0.28

2.4E+04

LogNormal

0.28

20.00

20.00

20.00

20.00

20.00

20.00

20.00

20.00

20.00

20.00

20.00

20.00

20.00

20.00

20.00

20.00

2.06E+03

1.10E+03

2.96E+03

1.58E+03

2.36E+03

1.67E+03

9.05E-01

4.82E-01

1.30E+00

6.96E-01

1.04E+00

7.40E-01

0.30

0.30

0.28

0.28

0.28

0.28

Each (5'x6' Panel)

Each (5'x6' Panel)

Each (5'x6' Panel)

Each (5'x6' Panel)

Each (5'x6' Panel)

Each (5'x6' Panel)

Each (5'x6' Panel)

Each (5'x6' Panel)

Each (5'x6' Panel)

Each (5'x6' Panel)

Each (5'x6' Panel)

Each (5'x6' Panel)

Each (5'x6' Panel)

Each (5'x6' Panel)

Each (5'x6' Panel)

Each (5'x6' Panel)

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

NO

Not Applicable

0%

0.00

NO

Not Applicable

0%

0.00

NO

Not Applicable

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

Damage state DS3 of glass fall out did not occur in physical testing to 10% drift. DS3 0.1 median demand is intentional.

By User

By User

By User

By User

2018-02-12 Added damage state data

Root Cost Multiplier:

Date Generated:

30

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2023.001

Generic Storefront, Config: Monolithic, Lamination: Unknown, Glass Type: Unknown, Details: Aspect ratio = 6:5, Other details Unknown

None

Line 328

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

SF 30

Story Drift Ratio

3

DS1

Sequential

Seq(DS1,DS2,DS3)

Gasket seal failure.

DS2

Sequential

Glass cracking.

DS3

Sequential

Glass falls out.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

No

Demand Location (floor above?)

No

Illustrations



B2022.003-DS1-1.JPG



B2022.001a-DS1-1.JPG



B2022.001a-DS2-1.JPG

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Consequence Functions

Repair Description

1.00

1.00

1.00

0.029

0.4492

0.25

0.5

NO

YES

Remove glass panel and replace damaged gaskets.

0.0473

0.14

0.25

0.25

Data Quality Superior

Data Relevance Average

Replace cracked glass panel.

0.07

0.99

0.25

0.25

Documentation Quality Superior

Rationality Superior

Replace cracked glass panel; cover exposure in meantime.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Time:

Environmental Impacts:

LifeSafety Hazard:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

7.70E+02

7.70E+02

1.40E+03

LogNormal

44.00

434.00

9.24E+02

5.39E+02

0.28

0.28

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

1.37E+03

1.37E+03

2.00E+03

LogNormal

44.00

434.00

0.00E+00

0.00E+00

0.17

0.17

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

1.37E+03

1.37E+03

2.00E+03

LogNormal

44.00

434.00

0.00E+00

0.00E+00

0.17

0.17

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

5.70E-01

5.70E-01

1.02E+00

LogNormal

44.00

434.00

6.83E-01

4.00E-01

0.38

0.38

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

1.02E+00

1.02E+00

1.47E+00

LogNormal

44.00

434.00

1.02E+00

1.02E+00

0.30

0.30

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

1.02E+00

1.02E+00

1.47E+00

LogNormal

44.00

434.00

1.02E+00

1.02E+00

0.30

0.30

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

Median Cost

Best Fit

CV or Beta

4.1E+02

LogNormal

0.38

1.0E+03

LogNormal

0.30

1.0E+03

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

4.1E+02

LogNormal

0.38

1.0E+03

LogNormal

0.30

2.4E+04

LogNormal

0.30

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

NO

Not Applicable

0%

0.00

NO

Not Applicable

0%

0.00

YES

36 SF

25%

0.50

0%

0.00

YES

50%

0.50

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

consequence.

By User

By User

By User

Not Given

2011-08-24 DS3 beta changed from 1 to 0.3 to avoid negative probabilities.

Root Cost Multiplier:

Date Generated:

30

02/26/19

Root Cost Multiplier: 30
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2023.011


Storefront, Config: Monolithic, Lamination: Laminated, Glass Type: Annealed, Details: 1/4 in. (6 mm) AN LAM (0.030 PVB); glass-frame clearance = 0.41 in. (10 mm); aspe

Line 330


None

Construction Quality:	Not Specified					<div>Quantity Rounding</div> <div>Round Qty?</div> <div>NO</div> <div>Allow sum by floor or building?</div> <div>No</div> <div>Demand Location (floor above?)</div> <div>No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	SF 30					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	3					
Damage State:	DS1	DS2	DS3			
Type of Damage State:	Sequential		Sequential		Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)					
Descriptions	Gasket seal failure.		Glass cracking.		Glass falls out.	


Illustrations



B2022.003-DS1-1.JPG



B2022.001a-DS1-1.JPG



B2022.001a-DS2-1.JPG

Damage State Probability:

1.00	1.00	1.00		
------	------	------	--	--

Fragility Parameters				
Median Demand, θ :	0.029	0.0567	0.08	
Data dispersion, β_d :	0.4492	0.14	0.99	
Uncertainty, β_u :	0.25	0.25	0.25	
Total Dispersion, β :	0.5	0.3	0.3	
Correlation (Yes / No)	NO		Data Quality Superior	Documentation Quality Superior
Directionality (Yes / No)	YES		Data Relevance Average	Rationality Superior

Consequence Functions

Repair Description

Remove glass panel and replace damaged gaskets.

Replace cracked glass panel.

Replace cracked glass panel; cover exposure in meantime.

Long Lead Time (Yes / No)	NO			NO			NO					
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	7.70E+02	7.70E+02	1.40E+03	1.37E+03	1.37E+03	2.00E+03	1.37E+03	1.37E+03	2.00E+03			
Best fit mean:	9.35E+02			1.55E+03			1.55E+03					
Best Fit Distribution:	LogNormal			LogNormal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	44.00		434.00	44.00		434.00	44.00		434.00			
Average Repair Cost (Min Qty, Max Qty)	9.24E+02		5.39E+02	0.00E+00		0.00E+00	0.00E+00		0.00E+00			
CV or beta (Min Qty, Max Qty)	0.28		0.28	0.17		0.17	0.17		0.17			
Quantity Unit:	Each (5'x6' Panel)			Each (5'x6' Panel)			Each (5'x6' Panel)					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.70E-01	5.70E-01	1.02E+00	1.02E+00	1.02E+00	1.47E+00	1.02E+00	1.02E+00	1.47E+00			
Best fit mean:	5.70E-01			1.02E+00			1.02E+00					
Best Fit Distribution:	LogNormal			LogNormal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	44.00		434.00	44.00		434.00	44.00		434.00			
Average Repair Time (Min Qty, Max Qty)	6.83E-01		4.00E-01	1.02E+00		1.02E+00	1.02E+00		1.02E+00			
CV or beta (Min Qty, Max Qty)	0.38		0.38	0.30		0.30	0.30		0.30			
Quantity Unit:	Each (5'x6' Panel)			Each (5'x6' Panel)			Each (5'x6' Panel)					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.1E+02	LogNormal	0.38	1.0E+03	LogNormal	0.30	1.0E+03	LogNormal	0.30			
Embodied Energy (MJ)	9.4E+03	LogNormal	0.38	2.4E+04	LogNormal	0.30	2.4E+04	LogNormal	0.30			
LifeSafety Hazard:												
Potential non-collapse casualties? (Yes / No)	NO			NO			YES					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			36 SF					
Serious Injury (Median, Dispersion)	0%		0.00	0%		0.00	25%		0.50			
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00	0%		0.00			
Post-event Tagging Flag:	NO			NO			YES					
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00	0%		0.00	50%		0.50			

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

By User

By User

By User

Not Given

2011-08-24 DS3 beta changed from 1 to 0.3 to avoid negative probabilities.

Root Cost Multiplier: 30

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2023.021

Storefront, Config: Monolithic, Lamination: Not laminated, Glass Type: Annealed, Details: 1/4 in. (6 mm) AN monolithic; glass-frame clearance = 0.41 in. (10 mm); aspect

None

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

SF 30

Story Drift Ratio

3

DS1

Sequential

Seq(DS1,DS2,DS3)

Gasket seal failure.

DS2

Sequential

Glass cracking.

DS3

Sequential

Glass falls out.

Quantity Rounding

Round Qty?

NO


Allow sum by floor or building?


No


Demand Location (floor above?)

No

Illustrations







B2022.003-DS1-1.JPG

B2022.001a-DS1-1.JPG

B2022.001a-DS2-1.JPG

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Consequence Functions

Repair Description

1.00

1.00

1.00

0.0303

0.424

0.25

0.5

0.0413

0.13

0.25

0.3

0.051

0.147

0.25

0.3

NO

YES

Data Quality

Superior

Documentation Quality

Superior

Rationality

Superior

Remove glass panel and replace damaged gaskets.

Replace cracked glass panel.

Replace cracked glass panel; cover exposure in meantime.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Time:

Environmental Impacts:

LifeSafety Hazard:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

NO

NO

YES

Not Applicable

Not Applicable

36 SF

0%

0.00

0%

0.00

NO

NO

YES

0%

0.00

0%

0.00

50%

0.50

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

By User

By User

By User

Not Given

2011-08-24 Negative probability deemed acceptable.

Root Cost Multiplier:

30

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2023.031

Storefront, Config: Monolithic, Lamination: Not laminated, Glass Type: Full tempered, Details: 3/8 in. (10 mm) FT monolithic, Planar Specimen; glass-frame clearance = 0

None

Line 332

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

SF 30

Story Drift Ratio

2

DS1

Sequential

Seq(DS1,DS2)

Glass cracking.

Not Specified

DS2

Sequential

Frame Damage

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

none

1.00

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.03

Not Specified

Not Specified

1

0.052

Not Specified

Not Specified

0.4

NO

YES

Data Quality

Not Rated

Documentation Quality

Not Rated

Rationality

Not Rated

Consequence Functions

Repair Description

Remove glass, replace frame, reinstall glass

Remove and replace frame and glass.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.37E+03

1.37E+03

2.00E+03

1.37E+03

1.37E+03

2.00E+03

1.55E+03

LogNormal

20.00

100.00

2.06E+03

1.10E+03

0.17

0.17

Each (5'x6' Panel)

6.03E-01

6.03E-01

8.82E-01

6.03E-01

6.03E-01

8.82E-01

6.85E-01

LogNormal

20.00

100.00

9.05E-01

4.82E-01

0.30

0.30

Each (5'x6' Panel)

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

1.0E+03

LogNormal

0.30

1.0E+03

LogNormal

0.30

2.4E+04

LogNormal

0.30

2.4E+04

LogNormal

0.30

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

NO

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

By User

By User

By User

By User

2018-02-12 consequence data added.

Root Cost Multiplier:

Date Generated:

30

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2023.032

Storefront, Config: Monolithic, Lamination: Not laminated, Glass Type: Full tempered, Details: 3/8 in. (10 mm) FT monolithic, Corner Cond. Specimen, in-plane; glass-frar

None

Line 333

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

SF 30

Story Drift Ratio

2

DS1

Sequential

Seq(DS1,DS2)

Glass cracking.

Not Specified

DS2

Sequential

Not Specified

Frame Damage

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

none	none			
1.00	1.00			

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.042

Not Specified

Not Specified

0.55

0.05

Not Specified

Not Specified

1

Data Quality

Not Rated

Documentation Quality

Not Rated

Rationality

Not Rated

Consequence Functions

Repair Description

Remove glass, replace frame, reinstall glass

Remove and replace frame and glass.

Long Lead Time (Yes / No)NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.37E+03	1.37E+03	2.00E+03	1.37E+03	1.37E+03	2.00E+03									
Best fit mean:	1.55E+03			1.55E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	20.00			20.00											
Average Repair Cost (Min Qty, Max Qty)	2.06E+03			2.06E+03											
CV or beta (Min Qty, Max Qty)	0.17			0.17											
Quantity Unit:	Each (5'x6' Panel)			Each (5'x6' Panel)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	6.03E-01	6.03E-01	8.82E-01	6.03E-01	6.03E-01	8.82E-01									
Best fit mean:	6.85E-01			6.85E-01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	20.00			20.00											
Average Repair Time (Min Qty, Max Qty)	9.05E-01			9.05E-01											
CV or beta (Min Qty, Max Qty)	0.30			0.30											
Quantity Unit:	Each (5'x6' Panel)			Each (5'x6' Panel)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.0E+03	LogNormal	0.30												
Embodied Energy (MJ)	2.4E+04	LogNormal	0.30												
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%			0%											
Loss of Life (Median, Dispersion)	0%			0%											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%			0%											

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

By User

By User

By User

By User

2018-02-12 consequence data added.

Root Cost Multiplier:

Date Generated:

30

02/26/19

Root Cost Multiplier: 30
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2023.034

Storefront, Config: Monolithic, Lamination: Not laminated, Glass Type: Full tempered, Details: 3/8 in. (10 mm) FT monolithic, Corner Cond. Specimen, Short side; glass-fr

None

Line 335

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

SF 30

Story Drift Ratio

2

DS1

Sequential

Seq(DS1,DS2)

Glass cracking.

Not Specified

DS2

Sequential

Not Specified

Frame Damage

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

none

1.00

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

NO

YES

Data Quality

Data Relevance

Not Rated

Not Rated

Documentation Quality

Rationality

Not Rated

Not Rated

Consequence Functions

Repair Description

Remove glass, replace frame, reinstall glass

Remove and replace frame and glass.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

1.37E+03

1.37E+03

2.00E+03

1.37E+03

1.37E+03

2.00E+03

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

6.03E-01

6.03E-01

8.82E-01

6.03E-01

6.03E-01

8.82E-01

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

4.1E+02

LogNormal

0.30

9.4E+03

LogNormal

0.30

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

By User

By User

By User

By User

2018-02-12 consequence data added.

Root Cost Multiplier:

Date Generated:

30

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description


B2023.041

Storefront, Config: Symmetric insulating glass units (dual-pane, equal-thickness IGU), Lamination: Not laminated, Glass Type: Annealed, Details: 1 in. (25 mm) AN IGU; gl
None


Line 336

Construction Quality:	Not Specified					<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? No</div> <div>Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	SF 30					
Demand Parameter (unit):	Story Drift Ratio					
Number of Damage States:	3					
Damage State:	DS1	DS2	DS3			
Type of Damage State:	Sequential	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2,DS3)					
Descriptions	Gasket seal failure. Glass cracking. Glass falls out.					


Illustrations



B2022.003-DS1-1.JPG



B2022.001a-DS1-1.JPG



B2022.001a-DS2-1.JPG

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

1.00

1.00

1.00

Correlation (Yes / No)

Directionality (Yes / No)

NO

YES

Data Quality Superior

Documentation Quality Superior

Rationality Superior

Directionality Average

Consequence Functions

Repair Description

Remove glass panel and replace damaged gaskets.

Replace cracked glass panel.

Replace cracked glass panel; cover exposure in meantime.

Long Lead Time (Yes / No)	NO			NO			NO								
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	7.70E+02	7.70E+02	1.40E+03	1.37E+03	1.37E+03	2.00E+03	1.37E+03	1.37E+03	2.00E+03						
Best fit mean:	9.35E+02			1.55E+03			1.55E+03								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	44.00		434.00	44.00		434.00	44.00		434.00						
Average Repair Cost (Min Qty, Max Qty)	9.24E+02		5.39E+02	0.00E+00		0.00E+00	0.00E+00		0.00E+00						
CV or beta (Min Qty, Max Qty)	0.28		0.28	0.17		0.17	0.17		0.17						
Quantity Unit:	Each (5'x6' Panel)			Each (5'x6' Panel)			Each (5'x6' Panel)								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.70E-01	5.70E-01	1.02E+00	1.02E+00	1.02E+00	1.47E+00	1.02E+00	1.02E+00	1.47E+00						
Best fit mean:	6.89E-01			1.15E+00			1.15E+00								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	44.00		434.00	44.00		434.00	44.00		434.00						
Average Repair Time (Min Qty, Max Qty)	6.83E-01		4.00E-01	1.02E+00		1.02E+00	1.02E+00		1.02E+00						
CV or beta (Min Qty, Max Qty)	0.38		0.38	0.30		0.30	0.30		0.30						
Quantity Unit:	Each (5'x6' Panel)			Each (5'x6' Panel)			Each (5'x6' Panel)								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.1E+02	LogNormal	0.38	1.0E+03	LogNormal	0.30	1.0E+03	LogNormal	0.30						
Embodied Energy (MJ)	9.4E+03	LogNormal	0.38	2.4E+04	LogNormal	0.30	2.4E+04	LogNormal	0.30						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			YES								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			36 SF								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		25%	0.50							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		50%	0.50							

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

By User

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

30

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2023.051

Storefront, Config: Symmetric insulating glass units (dual-pane, equal-thickness IGU), Lamination: Not laminated, Glass Type: Full tempered, Details: 1 in. (25 mm) FT IGL

None

Line 337

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

SF 30

Story Drift Ratio

2

DS1

Sequential

Seq(DS1,DS2)

Panel damage (no glass damage).

Not Specified

DS2

Sequential

Not Specified

Glass cracks.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

none

1.00

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.05

Not Specified

Not Specified

0.29

0.16

Not Specified

Not Specified

1

Data Quality

Not Rated

Data Relevance

Not Rated

Documentation Quality

Not Rated

Rationality

Not Rated

Consequence Functions

Repair Description

Remove panel, repair frame, replace panel.

Remove panel, replace glass, replace panel.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.97E+03

1.97E+03

2.60E+03

2.16E+03

LogNormal

20.00

100.00

2.96E+03

1.58E+03

0.12

0.12

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

1.97E+03

1.97E+03

2.60E+03

2.16E+03

LogNormal

20.00

100.00

2.96E+03

1.58E+03

0.12

0.12

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

8.70E-01

8.70E-01

1.15E+00

9.54E-01

LogNormal

20.00

100.00

1.30E+00

6.96E-01

0.28

0.28

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

8.70E-01

8.70E-01

1.15E+00

9.54E-01

LogNormal

20.00

100.00

1.30E+00

6.96E-01

0.28

0.28

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

1.0E+03

LogNormal

0.28

2.4E+04

LogNormal

0.28

Median Cost

Best Fit

CV or Beta

1.0E+03

LogNormal

0.28

2.4E+04

LogNormal

0.28

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

Median demand of 10% is intentional. Physical testing did not cause frame or glass cracking damage at 10% drift.

By User

By User

By User

By User

None

Root Cost Multiplier:

30

Date Generated:

02/26/19

Line 338

Storefront, Config: Symmetric insulating glass units (dual-pane, equal-thickness IGU), Lamination: Not laminated, Glass Type: Full tempered, Details: 1 in. (25 mm) FT IGU
None

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Demand Parameter (unit):	Story Drift Ratio	Unit less	Demand Location (floor above)? No		
Number of Damage States:	2				
Damage State:	DS1	DS2			
Type of Damage State:	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Panel damage (no glass damage).		Glass cracks.		

Illustrations

none	none			

Damage State Probability:

Fragility Parameters					
Median Demand, θ :	0.054	0.16			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, δ :	0.28	1			

Correlation (Yes / No)	NO	Data Quality	Not Rated	Documentation Quality	Not Rated
Directionality (Yes / No)	YES	Data Relevance	Not Rated	Rationality	Not Rated

Consequence Functions	Repair Description
$C_{\text{Repair}} = C_{\text{Repair}}^{\text{min}} + \frac{C_{\text{Repair}}^{\text{max}} - C_{\text{Repair}}^{\text{min}}}{\Delta t_{\text{Repair}}^{\text{max}} - \Delta t_{\text{Repair}}^{\text{min}}} (\Delta t_{\text{Repair}} - \Delta t_{\text{Repair}}^{\text{min}})$	<p>Repair cost is a function of repair time. The repair cost is calculated as the minimum repair cost plus the difference between the maximum and minimum repair cost multiplied by the difference between the repair time and the minimum repair time, divided by the difference between the maximum and minimum repair time.</p>

Remove panel, repair frame, replace panel. Remove panel, replace glass, replace panel.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.97E+03	1.97E+03	2.60E+03	1.97E+03	1.97E+03	2.60E+03												
Best fit mean:	2.16E+03			2.16E+03														
Best Fit Distribution:	LogNormal			LogNormal														
Quantity Plateau (Min Qty, Max Qty)	20.00		100.00	20.00		100.00												
Average Repair Cost (Min Qty, Max Qty)	2.96E+03		1.58E+03	2.96E+03		1.58E+03												
CV or beta (Min Qty, Max Qty)	0.12		0.12	0.12		0.12												
Quantity Unit:	Each (5'x6' Panel)			Each (5'x6' Panel)														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.70E-01	8.70E-01	1.15E+00	8.70E-01	8.70E-01	1.15E+00												
Best fit mean:	9.54E-01			9.54E-01														
Best Fit Distribution:	LogNormal			LogNormal														
Quantity Plateau (Min Qty, Max Qty)	20.00		100.00	20.00		100.00												
Average Repair Time (Min Qty, Max Qty)	1.30E+00		6.96E-01	1.30E+00		6.96E-01												
CV or beta (Min Qty, Max Qty)	0.28		0.28	0.28		0.28												
Quantity Unit:	Each (5'x6' Panel)			Each (5'x6' Panel)														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.1E+02	LogNormal	0.28	1.0E+03	LogNormal	0.28												
Embodied Energy (MJ)	9.4E+03	LogNormal	0.28	2.4E+04	LogNormal	0.28												
LifeSafety Hazard:																		
Potential non-collapse casualties? (Yes / No)	NO			NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00													
Post-event Tagging Flag:	NO			NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00													

Comments: Median demand of 10% is intentional. Physical testing did not cause frame or glass cracking damage at 10% drift.

Date Created:
Approved (YES / NO)?
Official (YES / NO) ?
Author:
Revisions:

Root Cost Multiplier: 30
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2023.053

Storefront, Config: Symmetric insulating glass units (dual-pane, equal-thickness IGU), Lamination: Not laminated, Glass Type: Full tempered, Details: 1 in. (25 mm) FT IGL

None

Line 339

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

SF 30

Story Drift Ratio

2

DS1

Sequential

Seq(DS1,DS2)

Panel damage (no glass damage).

Not Specified

DS2

Sequential

Not Specified

Glass cracks.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

none

1.00

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.05

Not Specified

Not Specified

0.28

0.16

Not Specified

Not Specified

1

NO

YES

Data Quality

Not Rated

Data Relevance

Not Rated

Documentation Quality

Not Rated

Rationality

Not Rated

Consequence Functions

Repair Description

Remove panel, repair frame, replace panel.

Remove panel, replace glass, replace panel.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.97E+03

1.97E+03

2.60E+03

2.16E+03

LogNormal

20.00

100.00

2.96E+03

1.58E+03

0.12

0.12

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

1.97E+03

1.97E+03

2.60E+03

2.16E+03

LogNormal

20.00

100.00

2.96E+03

1.58E+03

0.12

0.12

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

8.70E-01

8.70E-01

1.15E+00

9.54E-01

LogNormal

20.00

100.00

1.30E+00

6.96E-01

0.28

0.28

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

8.70E-01

8.70E-01

1.15E+00

9.54E-01

LogNormal

20.00

100.00

1.30E+00

6.96E-01

0.28

0.28

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

4.1E+02

LogNormal

0.28

1.0E+03

LogNormal

0.28

2.4E+04

LogNormal

0.28

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

Median demand of 10% is intentional. Physical testing did not cause frame or glass cracking damage at 10% drift.

By User

By User

By User

By User

None

Root Cost Multiplier:

Date Generated:

30

02/26/19

Line 340

Storefront, Config: Symmetric insulating glass units (dual-pane, equal-thickness IGU), Lamination: Not laminated, Glass Type: Full tempered, Details: 1 in. (25 mm) FT IGU
None

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Number of Damage States:	2	Damage States (not used): 1, 2			
Damage State:	DS1	DS2			
Type of Damage State:	Sequential	Sequential			
Seq(DS1,DS2)					
DS Hierarchy					
Descriptions	Panel damage (no glass damage).	Glass cracks.			

Illustrations

none	none			

Damage State Probability:

Fragility Parameters					
Median Demand, θ :	0.1	0.11			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, δ :	0.32	0.32			

Correlation (Yes / No)	NO	Data Quality	Not Rated	Documentation Quality	Not Rated
Directionality (Yes / No)	YES	Data Relevance	Not Rated	Rationality	Not Rated

Consequence Functions

Repair Description	Remove panel, repair frame, replace panel.	Remove panel, replace glass, replace panel.
Remove panel, repair frame, replace panel.	Remove panel, replace glass, replace panel.	

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.97E+03	1.97E+03	2.60E+03	1.97E+03	1.97E+03	2.60E+03												
Best fit mean:	2.16E+03			2.16E+03														
Best Fit Distribution:	LogNormal			LogNormal														
Quantity Plateau (Min Qty, Max Qty)	20.00		100.00	20.00		100.00												
Average Repair Cost (Min Qty, Max Qty)	2.96E+03		1.58E+03	2.96E+03		1.58E+03												
CV or beta (Min Qty, Max Qty)	0.12		0.12	0.12		0.12												
Quantity Unit:	Each (5'x6') Panel			Each (5'x6') Panel														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.70E-01	8.70E-01	1.15E+00	8.70E-01	8.70E-01	1.15E+00												
Best fit mean:	9.54E-01			9.54E-01														
Best Fit Distribution:	LogNormal			LogNormal														
Quantity Plateau (Min Qty, Max Qty)	20.00		100.00	20.00		100.00												
Average Repair Time (Min Qty, Max Qty)	1.30E+00		6.96E-01	1.30E+00		6.96E-01												
CV or beta (Min Qty, Max Qty)	0.28		0.28	0.28		0.28												
Quantity Unit:	Each (5'x6') Panel			Each (5'x6') Panel														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.1E+02	LogNormal	0.28	1.0E+03	LogNormal	0.28												
Embodied Energy (MJ)	9.4E+03	LogNormal	0.28	2.4E+04	LogNormal	0.28												
LifeSafety Hazard:																		
Potential non-collapse casualties? (Yes / No)	NO			NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00													
Post-event Tagging Flag:	NO			NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00													

Comments: Median demand of 10% is intentional. Physical testing did not cause frame or glass cracking damage at 10% drift.

Date Created:
Approved (YES / NO)?
Official (YES / NO) ?
Author:
Revisions:

Root Cost Multiplier: 30
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2023.055

Storefront, Config: Symmetric insulating glass units (dual-pane, equal-thickness IGU), Lamination: Not laminated, Glass Type: Full tempered, Details: 1 in. (25 mm) FT IGL

None

Line 341

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

SF 30

Story Drift Ratio

2

DS1

Sequential

Seq(DS1,DS2)

Panel damage (no glass damage).

Not Specified

DS2

Sequential

Not Specified

Glass cracks.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

none

1.00

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.055

Not Specified

Not Specified

0.29

0.055

Not Specified

Not Specified

0.32

NO

YES

Data Quality

Data Relevance

Not Rated

Not Rated

Documentation Quality

Rationality

Not Rated

Not Rated

Consequence Functions

Repair Description

Remove panel, repair frame, replace panel.

Remove panel, replace glass, replace panel.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.97E+03

1.97E+03

2.60E+03

2.16E+03

LogNormal

20.00

100.00

2.96E+03

1.58E+03

0.12

0.12

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

1.97E+03

1.97E+03

2.60E+03

2.16E+03

LogNormal

20.00

100.00

2.96E+03

1.58E+03

0.12

0.12

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

8.70E-01

8.70E-01

1.15E+00

9.54E-01

LogNormal

20.00

100.00

1.30E+00

6.96E-01

0.28

0.28

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

8.70E-01

8.70E-01

1.15E+00

9.54E-01

LogNormal

20.00

100.00

1.30E+00

6.96E-01

0.28

0.28

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

4.1E+02

LogNormal

0.28

1.0E+03

LogNormal

0.28

2.4E+04

LogNormal

0.28

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

Median demand of 10% is intentional. Physical testing did not cause frame or glass cracking damage at 10% drift.

By User

By User

By User

By User

None

Root Cost Multiplier:

Date Generated:

30

02/26/19

Root Cost Multiplier: 30
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2023.057

Storefront, Config: Symmetric insulating glass units (dual-pane, equal-thickness IGU), Lamination: Not laminated, Glass Type: Full tempered, Details: 1 in. (25 mm) FT IGL

None

Line 343

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

SF 30

Story Drift Ratio

2

DS1

Sequential

Seq(DS1,DS2)

Panel damage (no glass damage).

Not Specified

DS2

Sequential

Not Specified

Glass cracks.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

none

1.00

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.055

Not Specified

Not Specified

0.32

0.055

Not Specified

Not Specified

0.32

NO

YES

Data Quality

Data Relevance

Not Rated

Not Rated

Documentation Quality

Rationality

Not Rated

Not Rated

Consequence Functions

Repair Description

Remove panel, repair frame, replace panel.

Remove panel, replace glass, replace panel.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.97E+03

1.97E+03

2.60E+03

2.16E+03

LogNormal

20.00

100.00

2.96E+03

1.58E+03

0.12

0.12

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

1.97E+03

1.97E+03

2.60E+03

2.16E+03

LogNormal

20.00

100.00

2.96E+03

1.58E+03

0.12

0.12

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

8.70E-01

8.70E-01

1.15E+00

9.54E-01

LogNormal

20.00

100.00

1.30E+00

6.96E-01

0.28

0.28

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

8.70E-01

8.70E-01

1.15E+00

9.54E-01

LogNormal

20.00

100.00

1.30E+00

6.96E-01

0.28

0.28

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

4.1E+02

LogNormal

0.28

1.0E+03

LogNormal

0.28

2.4E+04

LogNormal

0.28

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

Median demand of 10% is intentional. Physical testing did not cause frame or glass cracking damage at 10% drift.

By User

By User

By User

By User

None

Root Cost Multiplier:

Date Generated:

30

02/26/19

Line 344

Storefront, Config: Symmetric insulating glass units (dual-pane, equal-thickness IGU), Lamination: Not laminated, Glass Type: Full tempered, Details: 1 in. (25 mm) FT IGU
None

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Number of Damage States:	2	
Damage State:	DS1	DS2
Type of Damage State:	Sequential	Sequential
DS Hierarchy	Seq(DS1,DS2)	
Descriptions	Panel damage (no glass damage).	Glass cracks.

Illustrations

none	none			

Damage State Probability:

Fragility Parameters					
Median Demand, θ :	0.09	0.1			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, δ :	1	0.32			

Correlation (Yes / No)	NO	Data Quality	Not Rated	Documentation Quality	Not Rated
Directionality (Yes / No)	YES	Data Relevance	Not Rated	Rationality	Not Rated

Consequence Functions	Repair Description

Remove panel, repair frame, replace panel. Remove panel, replace glass, replace panel.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.97E+03	1.97E+03	2.60E+03	1.97E+03	1.97E+03	2.60E+03												
Best fit mean:	2.16E+03			2.16E+03														
Best Fit Distribution:	LogNormal			LogNormal														
Quantity Plateau (Min Qty, Max Qty)	20.00		100.00	20.00		100.00												
Average Repair Cost (Min Qty, Max Qty)	2.96E+03		1.58E+03	2.96E+03		1.58E+03												
CV or beta (Min Qty, Max Qty)	0.12		0.12	0.12		0.12												
Quantity Unit:	Each (5'x6') Panel			Each (5'x6') Panel														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.70E-01	8.70E-01	1.15E+00	8.70E-01	8.70E-01	1.15E+00												
Best fit mean:	9.54E-01			9.54E-01														
Best Fit Distribution:	LogNormal			LogNormal														
Quantity Plateau (Min Qty, Max Qty)	20.00		100.00	20.00		100.00												
Average Repair Time (Min Qty, Max Qty)	1.30E+00		6.96E-01	1.30E+00		6.96E-01												
CV or beta (Min Qty, Max Qty)	0.28		0.28	0.28		0.28												
Quantity Unit:	Each (5'x6') Panel			Each (5'x6') Panel														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.1E+02	LogNormal	0.28	1.0E+03	LogNormal	0.28												
Embodied Energy (MJ)	9.4E+03	LogNormal	0.28	2.4E+04	LogNormal	0.28												
LifeSafety Hazard:																		
Potential non-collapse casualties? (Yes / No)	NO			NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00													
Post-event Tagging Flag:	NO			NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00													

Comments: Median demand of 10% is intentional. Physical testing did not cause frame or glass cracking damage at 10% drift.

Date Created:
Approved (YES / NO)?
Official (YES / NO) ?
Author:
Revisions:

Root Cost Multiplier: 30
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification B3011.011

NISTIR Name Concrete tile roof, tiles secured and compliant with UBC94

Description Costing per roofing square (100 SF)

Line 345

Construction Quality:	Any				
Seismic Installation Conditions:	Compliant with UBC 1994				
Fragility Unit of Measure:	SF 100				
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	2				
Damage State:	DS1	DS2			
Type of Damage State:	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Minor damage; tiles dislodged.	Major portion of tile dislodged.			

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	NO	NO

Illustrations



Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	1.1	1.4			
Data dispersion, β_d :	0.28	0.28			
Uncertainty, β_u :	0.25	0.25			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO	Data Quality Not Rated		Documentation Quality Not Rated	
Directionality (Yes / No)	NO	Data Relevance Not Rated		Rationality Not Rated	

Consequence Functions		
Repair Description	Reinstall dislodged tiles.	Reinstall dislodged tiles.

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	4.00E+02	7.00E+02	1.57E+03	1.15E+03	1.48E+03	2.39E+03									
Best fit mean:	7.43E+02			1.59E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	13.00 130.00			13.00 130.00											
Average Repair Cost (Min Qty, Max Qty)	8.40E+02 4.90E+02			2.22E+03 1.18E+03											
CV or beta (Min Qty, Max Qty)	0.58 0.58			0.31 0.31											
Quantity Unit:	100 ft^2 Units			100 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	4.00E-01	8.00E-01	1.70E+00	1.30E+00	1.60E+00	2.60E+00									
Best fit mean:	8.00E-01			1.60E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	13.00 130.00			13.00 130.00											
Average Repair Time (Min Qty, Max Qty)	9.54E-01 5.68E-01			2.42E+00 1.27E+00											
CV or beta (Min Qty, Max Qty)	0.63 0.63			0.40 0.40											
Quantity Unit:	100 ft^2 Units			100 ft^2 Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.1E+01	LogNormal	0.63	1.5E+02	LogNormal	0.40									
Embodied Energy (MJ)	9.9E+02	LogNormal	0.63	3.8E+03	LogNormal	0.40									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			50% 0.50											

Comments:	None				
Date Created:	Not Given				
Approved (YES / NO)?	By User				
Official (YES / NO) ?	By User				
Author:	Not Given				
Revisions:	None				
		Root Cost Multiplier:	100		
		Date Generated:	02/26/19		

FEMA P-58 Fragility Specification

NISTIR Classification B3011.012
NISTIR Name Clay tile roof, tiles secured and compliant with UBC94
Description Costing per roofing square (100 SF)

Line 346

Construction Quality:	Any			
Seismic Installation Conditions:	Compliant with UBC 1994			
Fragility Unit of Measure:	SF 100			
Demand Parameter (unit):	Peak Floor Acceleration g			
Number of Damage States:	2			
Damage State:	DS1	DS2		
Type of Damage State:	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2)			
Descriptions	Minor damage; tiles dislodged.		Major portion of tile dislodged.	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	No	

Illustrations

				
B3011.011-DS1-1.JPG	B3011.011-DS2-1.JPG			

Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	1.4	1.7			
Data dispersion, β_d :	0.2	0.20			
Uncertainty, β_u :	0.25	0.25			
Total Dispersion, β :	0.3	0.3			
Correlation (Yes / No)	NO		Data Quality Not Rated	Documentation Quality Not Rated	
Directionality (Yes / No)	NO		Data Relevance Not Rated	Rationality Not Rated	

Consequence Functions

Repair Description Replace and install dislodged tiles (assume 5% of area) Replace and install dislodged tiles.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	6.25E+02	1.03E+03	2.00E+03	1.35E+03	2.00E+03	3.35E+03									
Best fit mean:	1.07E+03			2.07E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 50.00			5.00 50.00											
Average Repair Cost (Min Qty, Max Qty)	1.33E+03 8.20E+02			3.00E+03 1.60E+03											
CV or beta (Min Qty, Max Qty)	0.48 0.48			0.37 0.37											
Quantity Unit:	100 ft^2 Units			100 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	6.90E-01	1.13E+00	2.21E+00	1.49E+00	2.21E+00	3.69E+00									
Best fit mean:	1.13E+00			2.21E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 50.00			5.00 50.00											
Average Repair Time (Min Qty, Max Qty)	1.47E+00 9.04E-01			3.31E+00 1.77E+00											
CV or beta (Min Qty, Max Qty)	0.54 0.54			0.45 0.45											
Quantity Unit:	100 ft^2 Units			100 ft^2 Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	5.6E+01	LogNormal	0.54	2.1E+02	LogNormal	0.45									
Embodied Energy (MJ)	1.3E+03	LogNormal	0.54	5.2E+03	LogNormal	0.45									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		50%	0.50										

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: None
Root Cost Multiplier: 100
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification B3011.013
NISTIR Name Concrete tile roof, unsecured tiles
Description Costing per roofing square (100 SF)

Line 347

Construction Quality:	Any				
Seismic Installation Conditions:	Compliant with UBC 1994				
Fragility Unit of Measure:	SF 100				
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	2				
Damage State:	DS1	DS2			
Type of Damage State:	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Minor damage; tiles dislodged.	Major portion of tile dislodged.			

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	No	

Illustrations

				
B3011.011-DS1-1.JPG	B3011.011-DS2-1.JPG			

Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.5	0.7			
Data dispersion, β_d :	0.28	0.28			
Uncertainty, β_u :	0.25	0.25			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO	Data Quality Not Rated		Documentation Quality Not Rated	
Directionality (Yes / No)	NO	Data Relevance Not Rated		Rationality Not Rated	

Consequence Functions		
Repair Description	Reinstall dislodged tiles.	Reinstall dislodged tiles.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.25E+02	6.25E+02	1.49E+03	7.00E+02	1.03E+03	1.94E+03									
Best fit mean:	6.56E+02			1.10E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 10.00			1.00 10.00											
Average Repair Cost (Min Qty, Max Qty)	8.13E+02 5.00E+02			1.55E+03 8.24E+02											
CV or beta (Min Qty, Max Qty)	0.64 0.64			0.43 0.43											
Quantity Unit:	100 ft^2 Units			100 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	3.60E-01	6.90E-01	1.64E+00	7.70E-01	1.14E+00	2.14E+00									
Best fit mean:	6.90E-01			1.14E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 10.00			1.00 10.00											
Average Repair Time (Min Qty, Max Qty)	8.97E-01 5.52E-01			1.71E+00 9.13E-01											
CV or beta (Min Qty, Max Qty)	0.68 0.68			0.50 0.50											
Quantity Unit:	100 ft^2 Units			100 ft^2 Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.4E+01	LogNormal	0.68	5.4E+01	LogNormal	0.50									
Embodied Energy (MJ)	5.8E+02	LogNormal	0.68	1.3E+03	LogNormal	0.50									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			50% 0.50											

Comments:	None				
Date Created:	Not Given				
Approved (YES / NO)?	By User				
Official (YES / NO) ?	By User				
Author:	Not Given				
Revisions:	None				
		Root Cost Multiplier:	100		
		Date Generated:	02/26/19		

FEMA P-58 Fragility Specification

NISTIR Classification B3011.014
NISTIR Name Clay tile roof, unsecured tiles
Description Costing per roofing square (100 SF)

Line 348

Construction Quality:	Any			
Seismic Installation Conditions:	Compliant with UBC 1994			
Fragility Unit of Measure:	SF 100			
Demand Parameter (unit):	Peak Floor Acceleration g			
Number of Damage States:	2			
Damage State:	DS1	DS2		
Type of Damage State:	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2)			
Descriptions	Minor damage; tiles dislodged.		Major portion of tile dislodged.	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

				
B3011.011-DS1-1.JPG	B3011.011-DS2-1.JPG			

Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.4	0.5			
Data dispersion, β_d :	0.2	0.20			
Uncertainty, β_u :	0.25	0.25			
Total Dispersion, β :	0.3	0.3			
Correlation (Yes / No)	NO		Data Quality Not Rated	Documentation Quality Not Rated	
Directionality (Yes / No)	NO		Data Relevance Not Rated	Rationality Not Rated	

Consequence Functions
Repair Description Replace and install dislodged tiles (assume 5% of area) Replace and install dislodged tiles.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	5.50E+02	9.50E+02	1.93E+03	9.00E+02	1.55E+03	2.90E+03									
Best fit mean:	9.90E+02			1.58E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 10.00			1.00 10.00											
Average Repair Cost (Min Qty, Max Qty)	1.24E+03 7.60E+02			2.33E+03 1.24E+03											
CV or beta (Min Qty, Max Qty)	0.51 0.51			0.47 0.47											
Quantity Unit:	100 ft^2 Units			100 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	6.10E-01	1.05E+00	2.12E+00	9.90E-01	1.71E+00	3.20E+00									
Best fit mean:	1.05E+00			1.71E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 10.00			1.00 10.00											
Average Repair Time (Min Qty, Max Qty)	1.36E+00 8.40E-01			2.56E+00 1.37E+00											
CV or beta (Min Qty, Max Qty)	0.57 0.57			0.53 0.53											
Quantity Unit:	100 ft^2 Units			100 ft^2 Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.0E+01	LogNormal	0.57	1.1E+02	LogNormal	0.53									
Embodied Energy (MJ)	9.2E+02	LogNormal	0.57	2.7E+03	LogNormal	0.53									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			50% 0.50											

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: None
Root Cost Multiplier: 100
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B3031.001a

Line 349

NISTIR Name
Description

Masonry Chimney - unreinforced, non industrial, above roof 5 ft, replace with masonry
Demand parameter shall be defined as the first floor peak floor acceleration. Unreinforced masonry chimney as a component of wood frame buildings. Includes firebox and chimney, excludes exterior veneer or ornamentation. May include chimneys where the quality of reinforcing is unknown. For multiple story buildings enter the chimney fragility once at the first floor, do not specify this fragility at subsequent elevated floors.

Construction Quality:
Seismic Installation Conditions:

Normal
All

Fragility Unit of Measure:	EA 1
Demand Parameter (unit):	Peak Floor Acceleration g
Number of Damage States:	2

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Damage State:	DS1	DS2			
Type of Damage State:	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Cracking with offset > 1/16"	Topping of all or a portion of the chimney.			

Illustrations



Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.35	0.5			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.6	0.6			
Correlation (Yes / No)	NO	Data Quality Not Rated		Documentation Quality Not Rated	
Directionality (Yes / No)	NO	Data Relevance Not Rated		Rationality Not Rated	

Consequence Functions
Repair Description

Rebuild above break or replace entire chimney.
Add comments (edit or delete as necessary):
Rebuilding with masonry will restore the chimney to its pre-earthquake condition. Some jurisdictions prohibit unreinforced reconstruction and require either replacement of the damaged portion of the chimney with a metal flue within wood frame chase or a complete removal of the existing fireplace and chimney with replacement with a code compliant reinforced masonry design.
Toppled chimney may cause damage to adjacent structure.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	6.37E+03	7.23E+03	9.09E+03	6.37E+03	7.23E+03	9.09E+03									
Best fit mean:	7.47E+03 LogNormal			7.47E+03 LogNormal											
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00											
Average Repair Cost (Min Qty, Max Qty)	9.39E+03 5.78E+03			1.08E+04 5.78E+03											
CV or beta (Min Qty, Max Qty)	0.14 0.14			0.14 0.14											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	7.03E+00	7.97E+00	1.00E+01	7.03E+00	7.97E+00	1.00E+01									
Best fit mean:	7.97E+00 LogNormal			7.97E+00 LogNormal											
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00											
Average Repair Time (Min Qty, Max Qty)	1.04E+01 6.38E+00			1.20E+01 6.38E+00											
CV or beta (Min Qty, Max Qty)	0.29 0.29			0.29 0.29											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.7E+03	LogNormal	0.29	2.7E+03	LogNormal	0.29									
Embodied Energy (MJ)	6.0E+04	LogNormal	0.29	6.0E+04	LogNormal	0.29									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	25% 0.50			50% 0.50											

Comments:

Date Created:
Approved (YES / NO)?
Official (YES / NO) ?
Author:
Revisions:

Rebuilding with masonry will restore the chimney to its pre-earthquake condition. Some jurisdictions prohibit unreinforced reconstruction and require either replacement of the damaged portion of the chimney with a metal flue within wood frame chase or a complete removal of the existing fireplace and chimney with replacement with a code compliant reinforced masonry design.
Not Given
By User
By User
Not Given
None
Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B3031.001b

Line 350

NISTIR Name
Description

Masonry Chimney - unreinforced, non industrial, above roof 10 ft, replace with masonry
Demand parameter shall be defined as the first floor peak floor acceleration. Unreinforced masonry chimney as a component of wood frame buildings. Includes firebox and chimney, excludes exterior veneer or ornamentation. May include chimneys where the quality of reinforcing is unknown. For multiple story buildings enter the chimney fragility once at the first floor, do not specify this fragility at subsequent elevated floors.

Construction Quality:
Seismic Installation Conditions:

Normal
All

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Peak Floor Acceleration g

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Cracking with offset > 1/16"
Topping of all or a portion of the chimney.

Illustrations



Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.35

0.5

Data dispersion, β_d :

Not Specified

Not Specified

Uncertainty, β_u :

Not Specified

Not Specified

Total Dispersion, β :

0.6

0.6

Correlation (Yes / No)

NO

Data Quality Not Rated

Documentation Quality Not Rated

Directionality (Yes / No)

NO

Data Relevance Not Rated

Rationality Not Rated

Consequence Functions

Repair Description

Rebuild above break or replace entire chimney.
Add comments (edit or delete as necessary):
Rebuilding with masonry will restore the chimney to its pre-earthquake condition. Some jurisdictions prohibit unreinforced reconstruction and require either replacement of the damaged portion of the chimney with a metal flue within wood frame chase or a complete removal of the existing fireplace and chimney with replacement with a code compliant reinforced masonry design.
Topped chimney may cause damage to adjacent structure.

Rebuild above break or replace entire chimney.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	9.52E+03	1.12E+04	1.46E+04	9.52E+03	1.12E+04	1.46E+04									
Best fit mean:	1.16E+04 LogNormal			1.16E+04 LogNormal											
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00											
Average Repair Cost (Min Qty, Max Qty)	1.46E+04 8.96E+03			1.68E+04 8.96E+03											
CV or beta (Min Qty, Max Qty)	0.17 0.17			0.17 0.17											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.05E+01	1.24E+01	1.61E+01	1.05E+01	1.24E+01	1.61E+01									
Best fit mean:	1.24E+01 LogNormal			1.24E+01 LogNormal											
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00											
Average Repair Time (Min Qty, Max Qty)	1.61E+01 9.88E+00			1.85E+01 9.88E+00											
CV or beta (Min Qty, Max Qty)	0.30 0.30			0.30 0.30											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.8E+03	LogNormal	0.30	4.8E+03	LogNormal	0.30									
Embodied Energy (MJ)	1.1E+05	LogNormal	0.30	1.1E+05	LogNormal	0.30									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	25% 0.50			50% 0.50											

Comments:

Rebuilding with masonry will restore the chimney to its pre-earthquake condition. Some jurisdictions prohibit unreinforced reconstruction and require either replacement of the damaged portion of the chimney with a metal flue within wood frame chase or a complete removal of the existing fireplace and chimney with replacement with a code compliant reinforced masonry design.
Topped chimney may cause damage to adjacent structure.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: None
Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B3031.001c

Line 351

NISTIR Name
Description

Masonry Chimney - unreinforced, non industrial, above roof 15 ft, replace with masonry
Demand parameter shall be defined as the first floor peak floor acceleration. Unreinforced masonry chimney as a component of wood frame buildings. Includes firebox and chimney, excludes exterior veneer or ornamentation. May include chimneys where the quality of reinforcing is unknown. For multiple story buildings enter the chimney fragility once at the first floor, do not specify this fragility at subsequent elevated floors.

Construction Quality:
Seismic Installation Conditions:

Normal
All

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Peak Floor Acceleration g

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Cracking with offset > 1/16"

Topping of all or a portion of the chimney.

Illustrations



Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.35

0.5

Data dispersion, β_d :

Not Specified

Not Specified

Uncertainty, β_u :

Not Specified

Not Specified

Total Dispersion, β :

0.6

0.6

Correlation (Yes / No)

NO

Data Quality Not Rated

Documentation Quality Not Rated

Directionality (Yes / No)

NO

Data Relevance Not Rated

Rationality Not Rated

Consequence Functions

Repair Description

Rebuild above break or replace entire chimney.
Add comments (edit or delete as necessary):
Rebuilding with masonry will restore the chimney to its pre-earthquake condition. Some jurisdictions prohibit unreinforced reconstruction and require either replacement of the damaged portion of the chimney with a metal flue within wood frame chase or a complete removal of the existing fireplace and chimney with replacement with a code compliant reinforced masonry design.
Topped chimney may cause damage to adjacent structure.

Rebuild above break or replace entire chimney.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.27E+04	1.52E+04	2.01E+04	1.27E+04	1.52E+04	2.01E+04									
Best fit mean:	1.57E+04			1.57E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Cost (Min Qty, Max Qty)	1.97E+04		1.21E+04	2.28E+04		1.21E+04									
CV or beta (Min Qty, Max Qty)	0.19		0.19	0.19		0.19									
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.40E+01	1.67E+01	2.21E+01	1.40E+01	1.67E+01	2.21E+01									
Best fit mean:	1.67E+01			1.67E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Time (Min Qty, Max Qty)	2.18E+01		1.34E+01	2.51E+01		1.34E+01									
CV or beta (Min Qty, Max Qty)	0.31		0.31	0.31		0.31									
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.9E+03	LogNormal	0.31	6.9E+03	LogNormal	0.31									
Embodied Energy (MJ)	1.5E+05	LogNormal	0.31	1.5E+05	LogNormal	0.31									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	25%	0.50		50%	0.50										

Comments:

Rebuilding with masonry will restore the chimney to its pre-earthquake condition. Some jurisdictions prohibit unreinforced reconstruction and require either replacement of the damaged portion of the chimney with a metal flue within wood frame chase or a complete removal of the existing fireplace and chimney with replacement with a code compliant reinforced masonry design.
Topped chimney may cause damage to adjacent structure.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: None
Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B3031.002a

Line 352

NISTIR Name
Description

Masonry Chimney - unreinforced, non industrial, above roof 5 ft, replace with framing
Demand parameter shall be defined as the first floor peak floor acceleration. Unreinforced masonry chimney as a component of wood frame buildings. Includes firebox and chimney, excludes exterior veneer or ornamentation. May include chimneys where the quality of reinforcing is unknown. For multiple story buildings enter the chimney fragility once at the first floor, do not specify this fragility at subsequent elevated floors.

Construction Quality:
Seismic Installation Conditions:

Normal
All

Fragility Unit of Measure:	EA 1
Demand Parameter (unit):	Peak Floor Acceleration g
Number of Damage States:	2

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Damage State:	DS1	DS2			
Type of Damage State:	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Cracking with offset > 1/16"	Topping of all or a portion of the chimney.			

Illustrations



Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.35	0.5			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.6	0.6			
Correlation (Yes / No)	NO	Data Quality Not Rated		Documentation Quality Not Rated	
Directionality (Yes / No)	NO	Data Relevance Not Rated		Rationality Not Rated	

Consequence Functions
Repair Description

Rebuild above break or replace entire chimney.
Add comments (edit or delete as necessary):
Rebuilding with masonry will restore the chimney to its pre-earthquake condition. Some jurisdictions prohibit unreinforced reconstruction and require either replacement of the damaged portion of the chimney with a metal flue within wood frame chase or a complete removal of the existing fireplace and chimney with replacement with a code compliant reinforced masonry design.
Topped chimney may cause damage to adjacent structure.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	4.50E+03	6.53E+03	8.11E+03	4.50E+03	6.53E+03	8.11E+03									
Best fit mean:	6.37E+03			6.37E+03											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	1.00			1.00											
Average Repair Cost (Min Qty, Max Qty)	9.79E+03			9.79E+03											
CV or beta (Min Qty, Max Qty)	0.22			0.22											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	4.96E+00	7.20E+00	8.94E+00	4.96E+00	7.20E+00	8.94E+00									
Best fit mean:	7.20E+00			7.20E+00											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	1.00			1.00											
Average Repair Time (Min Qty, Max Qty)	1.08E+01			1.08E+01											
CV or beta (Min Qty, Max Qty)	0.33			0.33											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.0E+03	Normal	0.33	2.0E+03	Normal	0.33									
Embodied Energy (MJ)	4.5E+04	Normal	0.33	4.5E+04	Normal	0.33									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	25% 0.50			50% 0.50											

Comments:

Date Created:
Approved (YES / NO)?
Official (YES / NO) ?
Author:
Revisions:

Rebuilding with masonry will restore the chimney to its pre-earthquake condition. Some jurisdictions prohibit unreinforced reconstruction and require either replacement of the damaged portion of the chimney with a metal flue within wood frame chase or a complete removal of the existing fireplace and chimney with replacement with a code compliant reinforced masonry design.
Not Given
By User
By User
Not Given
None
Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B3031.002b

Line 353

NISTIR Name
Description

Masonry Chimney - unreinforced, non industrial, above roof 10 ft, replace with framing
Demand parameter shall be defined as the first floor peak floor acceleration. Unreinforced masonry chimney as a component of wood frame buildings. Includes firebox and chimney, excludes exterior veneer or ornamentation. May include chimneys where the quality of reinforcing is unknown. For multiple story buildings enter the chimney fragility once at the first floor, do not specify this fragility at subsequent elevated floors.

Construction Quality:
Seismic Installation Conditions:

Normal
All

Fragility Unit of Measure:	EA 1
Demand Parameter (unit):	Peak Floor Acceleration g
Number of Damage States:	2

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Damage State:	DS1	DS2			
Type of Damage State:	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Cracking with offset > 1/16"	Topping of all or a portion of the chimney.			

Illustrations



Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.35	0.5			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.6	0.6			
Correlation (Yes / No)	NO	Data Quality Not Rated		Documentation Quality Not Rated	
Directionality (Yes / No)	NO	Data Relevance Not Rated		Rationality Not Rated	

Consequence Functions
Repair Description

Rebuild above break or replace entire chimney.
Add comments (edit or delete as necessary):
Rebuilding with masonry will restore the chimney to its pre-earthquake condition. Some jurisdictions prohibit unreinforced reconstruction and require either replacement of the damaged portion of the chimney with a metal flue within wood frame chase or a complete removal of the existing fireplace and chimney with replacement with a code compliant reinforced masonry design.
Toppled chimney may cause damage to adjacent structure.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	8.27E+03	9.80E+03	1.27E+04	8.27E+03	9.80E+03	1.27E+04									
Best fit mean:	1.01E+04			1.01E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00											
Average Repair Cost (Min Qty, Max Qty)	1.47E+04 7.84E+03			1.47E+04 7.84E+03											
CV or beta (Min Qty, Max Qty)	0.17 0.17			0.17 0.17											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.12E+00	1.08E+01	1.40E+01	9.12E+00	1.08E+01	1.40E+01									
Best fit mean:	1.08E+01			1.08E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00											
Average Repair Time (Min Qty, Max Qty)	1.62E+01 8.65E+00			1.62E+01 8.65E+00											
CV or beta (Min Qty, Max Qty)	0.30 0.30			0.30 0.30											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	3.5E+03	LogNormal	0.30	3.5E+03	LogNormal	0.30									
Embodied Energy (MJ)	7.7E+04	LogNormal	0.30	7.7E+04	LogNormal	0.30									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	25% 0.50			50% 0.50											

Comments:

Date Created:
Approved (YES / NO)?
Official (YES / NO) ?
Author:
Revisions:

Rebuilding with masonry will restore the chimney to its pre-earthquake condition. Some jurisdictions prohibit unreinforced reconstruction and require either replacement of the damaged portion of the chimney with a metal flue within wood frame chase or a complete removal of the existing fireplace and chimney with replacement with a code compliant reinforced masonry design.
Not Given
By User
By User
Not Given
None
Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

B3031.002c

Line 354

NISTIR Name
Description

Masonry Chimney - unreinforced, non industrial, above roof 15 ft, replace with framing
Demand parameter shall be defined as the first floor peak floor acceleration. Unreinforced masonry chimney as a component of wood frame buildings. Includes firebox and chimney, excludes exterior veneer or ornamentation. May include chimneys where the quality of reinforcing is unknown. For multiple story buildings enter the chimney fragility once at the first floor, do not specify this fragility at subsequent elevated floors.

Construction Quality:
Seismic Installation Conditions:

Normal
All

Fragility Unit of Measure:	EA 1
Demand Parameter (unit):	Peak Floor Acceleration g
Number of Damage States:	2

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Damage State:	DS1	DS2			
Type of Damage State:	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Cracking with offset > 1/16"	Topping of all or a portion of the chimney.			

Illustrations



Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.35	0.5			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.6	0.6			
Correlation (Yes / No)	NO	Data Quality Not Rated		Documentation Quality Not Rated	
Directionality (Yes / No)	NO	Data Relevance Not Rated		Rationality Not Rated	

Consequence Functions
Repair Description

Rebuild above break or replace entire chimney.
Add comments (edit or delete as necessary):
Rebuilding with masonry will restore the chimney to its pre-earthquake condition. Some jurisdictions prohibit unreinforced reconstruction and require either replacement of the damaged portion of the chimney with a metal flue within wood frame chase or a complete removal of the existing fireplace and chimney with replacement with a code compliant reinforced masonry design.
Toppled chimney may cause damage to adjacent structure.

Rebuild above break or replace entire chimney.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	9.54E+03	1.31E+04	1.48E+04	9.54E+03	1.31E+04	1.48E+04									
Best fit mean:	1.25E+04			1.25E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Cost (Min Qty, Max Qty)	1.96E+04		1.05E+04	1.96E+04		1.05E+04									
CV or beta (Min Qty, Max Qty)	0.16		0.16	0.16		0.16									
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.05E+01	1.44E+01	1.63E+01	1.05E+01	1.44E+01	1.63E+01									
Best fit mean:	1.44E+01			1.44E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Time (Min Qty, Max Qty)	2.16E+01		1.15E+01	2.16E+01		1.15E+01									
CV or beta (Min Qty, Max Qty)	0.30		0.30	0.30		0.30									
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.9E+03	Normal	0.30	4.9E+03	Normal	0.30									
Embodied Energy (MJ)	1.1E+05	Normal	0.30	1.1E+05	Normal	0.30									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	25%	0.50		50%	0.50										

Comments:

Date Created:
Approved (YES / NO)?
Official (YES / NO) ?
Author:
Revisions:

Rebuilding with masonry will restore the chimney to its pre-earthquake condition. Some jurisdictions prohibit unreinforced reconstruction and require either replacement of the damaged portion of the chimney with a metal flue within wood frame chase or a complete removal of the existing fireplace and chimney with replacement with a code compliant reinforced masonry design.
Not Given
By User
By User
Not Given
None

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

C1011.001a

NISTIR Name
Description

Wall Partition, Type: Gypsum with metal studs, Full Height, Fixed Below, Fixed Above
Quantity is based upon 13'x100' Panels. Quantity of wall damaged varies by damage state.

Line 356

Construction Quality:	Normal					<div>Quantity RoundingRound Qty?NO</div> <div>Allow sum by floor or building?NO</div> <div>Demand Location (floor above?)No</div>
Seismic Installation Conditions:	Unknown					
Fragility Unit of Measure:	LF 100					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	3					
Damage State:	DS1		DS2		DS3	
Type of Damage State:	Sequential		Sequential		Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)					
Descriptions	Screw pop-out, cracking of wall board, warping or cracking of tape, slight crushing of wall panel at corners.		Moderate cracking or crushing of gypsum wall boards (typically in corners). Moderate corner gap openings, bending of boundary studs.		Buckling of studs and tearing of tracks. Tearing or bending of top track, tearing at corners with transverse walls, large gap openings, walls displaced.	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	NO	

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.005	0.01	0.021		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified		
Total Dispersion, β :	0.4	0.3	0.2		
Correlation (Yes / No)	NO	Data Quality Superior	Documentation Quality Superior		
Directionality (Yes / No)	YES	Data Relevance Superior	Rationality Not Rated		

Consequence Functions
Repair Description

Retape joints, paste and repaint. May require cutting and replacing corner sections of board. Repair 5% wallboard, 10% retape, 25% repaint.

Remove and replace 10% of wall board (both sides), retape and paste 25% of wall, paint 50% of wall. Replace boundary studs of approximately 5 intersections per 100 ft of wall length.

Remove and replace 50% of length of metal stud wall, 50% of both sides of the gypsum, and any embedded utilities. Retape and paste as required. Repair 100%.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	7.00E+02	1.79E+03	2.93E+03	1.85E+03	4.55E+03	8.70E+03	7.15E+03	8.75E+03	1.17E+04						
Best fit mean:	1.80E+03 Normal			4.30E+03 LogNormal			8.99E+03 LogNormal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	1.00 10.00			1.00 10.00			1.00 10.00								
Average Repair Cost (Min Qty, Max Qty)	2.68E+03 1.43E+03			6.83E+03 3.64E+03			1.05E+04 7.44E+03								
CV or beta (Min Qty, Max Qty)	0.48 0.48			0.56 0.56			0.20 0.20								
Quantity Unit:	1300 ft^2			1300 ft^2			1300 ft^2								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.20E-01	1.43E+00	2.34E+00	1.43E+00	3.51E+00	6.76E+00	5.59E+00	6.76E+00	9.10E+00						
Best fit mean:	1.43E+00 Normal			3.32E+00 LogNormal			7.00E+00 LogNormal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	1.00 10.00			1.00 10.00			1.00 10.00								
Average Repair Time (Min Qty, Max Qty)	2.13E+00 1.15E+00			5.28E+00 2.80E+00			8.12E+00 5.74E+00								
CV or beta (Min Qty, Max Qty)	0.54 0.54			0.61 0.61			0.32 0.32								
Quantity Unit:	1300 ft^2			1300 ft^2			1300 ft^2								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.1E+02	Normal	0.54	5.9E+02	LogNormal	0.61	1.3E+04	LogNormal	0.32						
Embodied Energy (MJ)	5.0E+03	Normal	0.54	1.5E+04	LogNormal	0.61	1.5E+05	LogNormal	0.32						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			NO								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								

Comments:

None

Date Created:
Approved (YES / NO)?
Official (YES / NO) ?
Author:
Revisions:

Not Given
By User
By User
Not Given
2015-07-26 Revised DS1,2,3 description, consequence text; 2016-03-08 Revised for new cost and time consequence data

Root Cost Multiplier: 1300
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

C1011.001b

NISTIR Name
Description

Wall Partition, Type: Gypsum with metal studs, Partial Height, Fixed Below, Lateral Braced Above
Quantity is based upon 13'x100' Panels. Quantity of wall damaged varies by damage state.

Line 357

Construction Quality:		Normal		<div>Quantity RoundingRound Qty?NO</div> <div>Allow sum by floor or building?NO</div> <div>Demand Location (floor above?)No</div>	
Seismic Installation Conditions:		Unknown			
Fragility Unit of Measure:		LF 100			
Demand Parameter (unit):		Story Drift RatioUnit less			
Number of Damage States:		3			
Damage State:		DS1		DS2	
				DS3	
Type of Damage State:		Sequential		Sequential	
DS Hierarchy		Seq(DS1,DS2,DS3)			
Descriptions		Screw pop-out, cracking of wall board, warping or cracking of tape, slight crushing of wall panel at corners.		Moderate cracking or crushing of gypsum wall boards (typically in corners). Moderate corner gap openings, bending of boundary studs.	
				Buckling of studs and tearing of tracks. Tearing or bending of top track, tearing at corners with transverse walls, large gap openings, walls displaced.	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	NO	NO

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.01	0.013	0.018		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified		
Total Dispersion, β :	0.3	0.3	0.3		
Correlation (Yes / No)	NO	Data Quality Superior	Documentation Quality Superior		
Directionality (Yes / No)	YES	Data Relevance Superior	Rationality Not Rated		

Consequence Functions
Repair Description

Retape joints, paste and repaint. May require cutting and replacing corner sections of board. Repair 5% wallboard, 10% retape, 25% repaint.

Remove and replace 10% of wall board (both sides), retape and paste 25% of wall, paint 50% of wall. Replace boundary studs of approximately 5 intersections per 100 ft of wall length.

Remove and replace 50% of length of metal stud wall, 50% of both sides of the gypsum, and any embedded utilities. Retape and paste as required. Repaint 100%.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	7.00E+02	1.79E+03	2.93E+03	1.85E+03	4.55E+03	8.70E+03	7.15E+03	8.75E+03	1.17E+04						
Best fit mean:	1.80E+03 Normal			4.30E+03 LogNormal			8.99E+03 LogNormal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	1.00 10.00			1.00 10.00			1.00 10.00								
Average Repair Cost (Min Qty, Max Qty)	3.57E+03 1.07E+03			9.10E+03 2.73E+03			1.75E+04 5.25E+03								
CV or beta (Min Qty, Max Qty)	0.48 0.48			0.56 0.56			0.20 0.20								
Quantity Unit:	1300 ft^2			1300 ft^2			1300 ft^2								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.20E-01	1.43E+00	2.34E+00	1.43E+00	3.51E+00	6.76E+00	5.59E+00	6.76E+00	9.10E+00						
Best fit mean:	1.43E+00 Normal			3.32E+00 LogNormal			7.00E+00 LogNormal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	1.00 10.00			1.00 10.00			1.00 10.00								
Average Repair Time (Min Qty, Max Qty)	2.82E+00 8.74E-01			7.06E+00 2.09E+00			1.36E+01 4.03E+00								
CV or beta (Min Qty, Max Qty)	0.54 0.54			0.61 0.61			0.32 0.32								
Quantity Unit:	1300 ft^2			1300 ft^2			1300 ft^2								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.1E+02	Normal	0.54	5.9E+02	LogNormal	0.61	1.3E+04	LogNormal	0.32						
Embodied Energy (MJ)	5.0E+03	Normal	0.54	1.5E+04	LogNormal	0.61	1.5E+05	LogNormal	0.32						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			NO								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								

Comments:

None

Date Created:
Approved (YES / NO)?
Official (YES / NO) ?
Author:
Revisions:

Not Given
By User
By User
Not Given
2015-07-26 Revised DS1,2,3 description, consequence text; 2016-03-08 Revised for new cost and time consequence data

Root Cost Multiplier: 1300
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

C1011.001d

Wall Partition, Type: Gypsum with metal studs, Full Height, Fixed Below, Slip Track Above w/o returns (friction connections)

Quantity is based upon 13'x100' Panels. Quantity of wall damaged varies by damage state.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

Unknown

LF 100

Story Drift Ratio

2

DS1

Sequential

Seq(DS1,DS2)

Screw pop-out, cracking of wall board, warping or cracking of tape, slight crushing of wall panel at corners.

Moderate cracking or crushing of gypsum wall boards (typically in corners). Moderate corner gap openings, bending of boundary studs.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

none

1.00

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.0035

Not Specified

Not Specified

0.6

NO

YES

0.0095

Not Specified

Not Specified

0.45

Data Quality Superior

Data Relevance Superior

Documentation Quality Superior

Rationality Not Rated

Consequence Functions

Repair Description

Retape joints, paste and repaint. May require cutting and replacing corner sections of board. Repair 5% wallboard, 10% retape, 25% repaint.

Remove and replace 10% of wall board (both sides), retape and paste 25% of wall, paint 50% of wall. Replace boundary studs of approximately 5 intersections per 100 ft of wall length.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

3.50E+02

8.93E+02

1.46E+03

9.25E+02

2.28E+03

4.35E+03

9.02E+02

Normal

2.15E+03

LogNormal

1.00

10.00

1.00

10.00

1.79E+03

5.36E+02

4.55E+03

1.37E+03

0.48

0.48

0.56

0.56

1300 ft^2

1300 ft^2

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.60E-01

6.50E-01

1.17E+00

7.80E-01

1.82E+00

3.38E+00

6.93E-01

Normal

1.72E+00

LogNormal

1.00

10.00

1.00

10.00

1.35E+00

3.72E-01

3.59E+00

1.11E+00

0.54

0.54

0.61

0.61

1300 ft^2

1300 ft^2

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

1.0E+02

Normal

0.54

3.0E+02

LogNormal

0.61

2.5E+03

Normal

0.54

7.5E+03

LogNormal

0.61

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2015-07-26 Revised DS1,2,3 description, consequence text; 2015-08-13 Removed DS3 data - no such damage state or consequence; 2016-03-08 Revised for new cost and time consequence data

Root Cost Multiplier:

Date Generated:

1300

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

C1011.011a

NISTIR Name
Description

Wall Partition, Type: Gypsum with wood studs, Full Height, Fixed Below, Fixed Above
Quantity is based upon 13'x100' Panels. Quantity of wall damaged varies by damage state.

Line 360

Construction Quality:	Normal			
Seismic Installation Conditions:	Unknown			
Fragility Unit of Measure:	LF 100			
Demand Parameter (unit):	Story Drift Ratio Unit less			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,MutEx(DS2,DS3))			
Descriptions	Cracking of paint over fasteners or joints.	Local and global buckling out-of-plane and crushing of gypsum wallboards. Studs are typically not damaged by failure of the gypsum wallboard.	Local and global buckling out-of-plane and crushing of gypsum wallboards. Studs are typically not damaged by failure of the gypsum wallboard.	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

none	none	none		
1.00	0.80	0.20		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.0021	0.0071	0.0071		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified		
Total Dispersion, β :	0.6	0.45	0.45		
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Superior		Rationality Not Rated	

Consequence Functions
Repair Description

Gypsum wallboard repaired by replacing the tape along the seam of two adjacent panels, applying new joint compound, sanding, and repainting.

Replace 25 feet of the affected panel along with the application of new tape, joint compound, followed by sanding and repainting. Studs are not damaged.

Replace 100 feet of the affected panel along with the application of new tape, joint compound, followed by sanding and repainting. Studs are not damaged.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	7.00E+02	2.17E+03	3.00E+03	2.05E+03	5.55E+03	8.90E+03	1.55E+04	1.70E+04	2.65E+04						
Best fit mean:	1.96E+03 Normal			5.50E+03 Normal			1.90E+04 LogNormal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	1.00 10.00			1.00 10.00			1.00 10.00								
Average Repair Cost (Min Qty, Max Qty)	4.34E+03 1.30E+03			1.11E+04 3.33E+03			3.39E+04 1.02E+04								
CV or beta (Min Qty, Max Qty)	0.46 0.46			0.49 0.49			0.24 0.24								
Quantity Unit:	1300 ft^2			1300 ft^2			1300 ft^2								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.20E-01	1.69E+00	2.34E+00	1.56E+00	4.29E+00	6.89E+00	1.21E+01	1.33E+01	2.07E+01						
Best fit mean:	1.52E+00 Normal			4.25E+00 Normal			1.49E+01 LogNormal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	1.00 10.00			1.00 10.00			1.00 10.00								
Average Repair Time (Min Qty, Max Qty)	3.38E+00 1.01E+00			8.62E+00 2.56E+00			2.65E+01 7.98E+00								
CV or beta (Min Qty, Max Qty)	0.52 0.52			0.55 0.55			0.34 0.34								
Quantity Unit:	1300 ft^2			1300 ft^2			1300 ft^2								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.3E+02	Normal	0.52	6.6E+02	Normal	0.55	3.5E+04	LogNormal	0.27						
Embodied Energy (MJ)	5.6E+03	Normal	0.52	1.7E+04	Normal	0.55	3.4E+05	LogNormal	0.27						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			NO								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2016-03-08 Revised for new cost and time consequence data

Root Cost Multiplier: 1300
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

C2011.001a




NISTIR Name
Description

Prefabricated steel stair with steel treads and landings with seismic joints that accommodate drift.
Flexible stair with seismic interstory slip joint. Steel prefab stringers, steel or concrete filled pan treads.

Line 361

Construction Quality:	Normal				Quantity Rounding	Round Qty?	YES
Seismic Installation Conditions:	All				Allow sum by floor or building? FLR		
Fragility Unit of Measure:	EA 1				Demand Location (floor above?) No		
Demand Parameter (unit):	Story Drift Ratio		Unit less				
Number of Damage States:	3						
Damage State:	DS1		DS2		DS3		
Type of Damage State:	Sequential		Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)						
Descriptions	Non structural damage, local steel yielding.		Structural damage but live load capacity remains intact. Buckling of steel, weld cracking.		Loss of live load capacity. Connection and or weld fracture.		

Illustrations

				
C2011.001a-DS1-1.jpg	C2011.001a-DS2-1.jpg	C2011.001a-DS2-1.jpg		

Damage State Probability:	1.00	1.00	1.00	
Fragility Parameters				
Median Demand, θ :	By User	By User	By User	
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified	
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified	
Total Dispersion, β :	By User	By User	By User	
Correlation (Yes / No)	NO	Data Quality Marginal	Documentation Quality Average	
Directionality (Yes / No)	YES	Data Relevance Marginal	Rationality Not Rated	
Consequence Functions				
Repair Description	Patch, paint.	Removal and replacement of damaged components. Field repair of damage (such as welding). Repair finishes.	Replace stair and handrail. Repair and replace affected soffits and floor finishes.	

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	7.00E+02	2.17E+03	3.00E+03	2.05E+03	5.55E+03	8.90E+03	1.55E+04	1.70E+04	2.65E+04						
Best fit mean:	1.96E+03 Normal			5.50E+03 Normal			1.90E+04 LogNormal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	1.00 10.00			1.00 10.00			1.00 10.00								
Average Repair Cost (Min Qty, Max Qty)	4.34E+03 1.30E+03			1.11E+04 3.33E+03			3.39E+04 1.02E+04								
CV or beta (Min Qty, Max Qty)	0.46 0.46			0.49 0.49			0.24 0.24								
Quantity Unit:	1300 ft^2			1300 ft^2			1300 ft^2								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.20E-01	1.69E+00	2.34E+00	1.56E+00	4.29E+00	6.89E+00	1.21E+01	1.33E+01	2.07E+01						
Best fit mean:	1.52E+00 Normal			4.25E+00 Normal			1.49E+01 LogNormal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	1.00 10.00			1.00 10.00			1.00 10.00								
Average Repair Time (Min Qty, Max Qty)	3.38E+00 1.01E+00			8.62E+00 2.56E+00			2.65E+01 7.98E+00								
CV or beta (Min Qty, Max Qty)	0.52 0.52			0.55 0.55			0.34 0.34								
Quantity Unit:	1300 ft^2			1300 ft^2			1300 ft^2								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.0E+01	LogNormal	1.02	3.4E+02	LogNormal	0.63	2.2E+04	Normal	0.47						
Embodied Energy (MJ)	9.4E+02	LogNormal	1.02	8.7E+03	LogNormal	0.63	3.0E+05	Normal	0.47						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		75%	0.50							

Comments: User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2011-08-24 DS2 beta changed from 0.08 to 0.15 to avoid negative probability above 0.5% drift.

Root Cost Multiplier: 1300
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

C2011.001b

NISTIR Name

Prefabricated steel stair with steel treads and landings with no seismic joint.

Description

Flexible stair without seismic interstory slip joint. Steel prefab stringers, steel or concrete filled pan treads.

Line 362

Construction Quality:

Normal

Seismic Installation Conditions:

All

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?	FLR	
Demand Location (floor above?)	No	

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

Non structural damage, local steel yielding.

Buckling of steel, weld cracking.

Loss of live load capacity. Connection and or weld fracture.

Illustrations



Damage State Probability:

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.005

0.017

0.028

Data dispersion, β_d :

Not Specified

Not Specified

Not Specified

Uncertainty, β_u :

Not Specified

Not Specified

Not Specified

Total Dispersion, β :

0.6

0.6

0.45

Correlation (Yes / No)

NO

Directionality (Yes / No)

YES

Data Quality Marginal

Data Relevance Marginal

Documentation Quality Average

Rationality Not Rated

Consequence Functions

Repair Description

Patch, paint.

Removal and replacement of damaged components. Field repair of damage (such as welding). Repair finishes.

Replace stair and handrail. Repair and replace affected soffits and floor finishes.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	7.00E+02	2.17E+03	3.00E+03	2.05E+03	5.55E+03	8.90E+03	1.80E+04	1.88E+04	2.28E+04						
Best fit mean:	1.96E+03			5.50E+03			1.98E+04								
Best Fit Distribution:	Normal			Normal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00 10.00			1.00 10.00			1.00 10.00								
Average Repair Cost (Min Qty, Max Qty)	4.34E+03 1.30E+03			1.11E+04 3.33E+03			3.76E+04 1.13E+04								
CV or beta (Min Qty, Max Qty)	0.46 0.46			0.49 0.49			0.10 0.10								
Quantity Unit:	1300 ft^2			1300 ft^2			1300 ft^2								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.20E-01	1.69E+00	2.34E+00	1.56E+00	4.29E+00	6.89E+00	1.40E+01	1.47E+01	1.78E+01						
Best fit mean:	1.52E+00			4.25E+00			1.54E+01								
Best Fit Distribution:	Normal			Normal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00 10.00			1.00 10.00			1.00 10.00								
Average Repair Time (Min Qty, Max Qty)	3.38E+00 1.01E+00			8.62E+00 2.56E+00			2.93E+01 8.83E+00								
CV or beta (Min Qty, Max Qty)	0.52 0.52			0.55 0.55			0.27 0.27								
Quantity Unit:	1300 ft^2			1300 ft^2			1300 ft^2								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.0E+01	LogNormal	1.02	3.4E+02	LogNormal	0.63	2.2E+04	Normal	0.47						
Embodied Energy (MJ)	9.4E+02	LogNormal	1.02	8.7E+03	LogNormal	0.63	3.0E+05	Normal	0.47						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			75% 0.50								

Comments:

Confirm median demand and dispersion values

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2011-08-24 DS2 beta changed from 0.08 to 0.15 to avoid negative probability above 0.5% drift.

Root Cost Multiplier: 1300

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

C2011.011a

Non-monolithic precast concrete stair assembly with concrete stringers and treads with seismic joints that accommodate drift.

Rigid stair with seismic interstory drift joint. Precast concrete stair.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

All

EA 1

Story Drift Ratio

3

DS1

DS2

DS3

Sequential

Sequential

Sequential

Seq(DS1,DS2,DS3)

Non structural damage, local concrete cracking, localized concrete spalling, localized rebar yielding.

Structural damage but live load capacity remains intact. Extensive concrete cracking, concrete crushing, buckling of rebar.

Loss of live load capacity. Extensive concrete crushing, connection failure.

Quantity Rounding

Round Qty?

YES


Allow sum by floor or building?

FLR

Demand Location (floor above?)


No

Illustrations




C2011.011a-DS1-1.jpg

1.00



C2011.011a-DS2-1.jpg

1.00



C2011.011a-DS2-1.jpg

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

By User

Not Specified

Not Specified

By User

NO

YES

Data Quality

Data Relevance

Marginal

Marginal

Documentation Quality

Average

Rationality

Not Rated

Consequence Functions

Repair Description

Patch, paint, epoxy injection. Repair finishes.

Remove damaged components, install replacement components.

Replace stair and handrail. Repair and replace affected soffits and floor finishes.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.00E+02

7.00E+02

1.70E+03

6.14E+02

LogNormal

5.00

10.00

1.40E+03

4.20E+02

0.80

0.80

Each

P₁₀

P₅₀

P₉₀

1.80E+03

3.70E+03

7.70E+03

3.71E+03

LogNormal

5.00

10.00

7.40E+03

2.22E+03

0.57

0.57

Each

P₁₀

P₅₀

P₉₀

1.26E+04

2.30E+04

3.41E+04

2.32E+04

Normal

5.00

10.00

4.59E+04

1.38E+04

0.36

0.36

Each

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.10E-01

7.72E-01

1.88E+00

7.72E-01

LogNormal

5.00

10.00

1.54E+00

4.63E-01

0.84

0.84

Each

P₁₀

P₅₀

P₉₀

1.99E+00

4.08E+00

8.49E+00

4.08E+00

LogNormal

5.00

10.00

8.16E+00

2.45E+00

0.62

0.62

Each

P₁₀

P₅₀

P₉₀

1.39E+01

2.53E+01

3.76E+01

2.53E+01

Normal

5.00

10.00

5.06E+01

1.52E+01

0.44

0.44

Each

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

1.4E+02

LogNormal

0.84

7.3E+02

LogNormal

0.62

2.6E+04

Normal

0.44

Median Cost

Best Fit

CV or Beta

3.2E+03

LogNormal

0.84

2.1E+04

LogNormal

0.62

3.5E+05

Normal

0.44

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

YES

75%

0.50

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

C2011.011b

NISTIR Name

Non-monolithic precast concrete stair assembly with concrete stringers and treads with no seismic joint.

Description

Rigid stair without seismic interstory drift joint. Precast concrete stair.

Line 364

Construction Quality:

Normal

Seismic Installation Conditions:

All

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

Non structural damage, local concrete cracking, localized concrete spalling, localized rebar yielding.

Structural damage but live load capacity remains intact. Extensive concrete cracking, concrete crushing, buckling of rebar.

Loss of live load capacity. Extensive concrete crushing, connection failure.

Quantity Rounding

Round Qty? YES

Allow sum by floor or building? FLR

Demand Location (floor above?) No

Illustrations



C2011.011a-DS1-1.jpg



C2011.011a-DS2-1.jpg



C2011.011a-DS2-1.jpg

Damage State Probability:

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.005

0.017

0.028

Data dispersion, β_d :

Not Specified

Not Specified

Not Specified

Uncertainty, β_u :

Not Specified

Not Specified

Not Specified

Total Dispersion, β :

0.6

0.6

0.45

Correlation (Yes / No)

NO

Directionality (Yes / No)

YES

Data Quality Marginal

Data Relevance Marginal

Documentation Quality Average

Rationality Not Rated

Consequence Functions

Repair Description

Patch, paint, epoxy injection. Repair finishes.

Remove damaged components, install replacement components.

Replace stair and handrail. Repair and replace affected soffits and floor finishes.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Cost by Damage State:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Best fit mean:

1.00E+02

7.00E+02

1.70E+03

1.80E+03

3.70E+03

7.70E+03

1.26E+04

2.30E+04

3.41E+04

Best Fit Distribution:

6.14E+02

LogNormal

3.71E+03

LogNormal

2.32E+04

Normal

Quantity Plateau (Min Qty, Max Qty)

5.00

10.00

5.00

10.00

5.00

10.00

Average Repair Cost (Min Qty, Max Qty)

1.40E+03

4.20E+02

7.40E+03

2.22E+03

4.59E+04

1.38E+04

CV or beta (Min Qty, Max Qty)

0.80

0.80

0.57

0.57

0.36

0.36

Quantity Unit:

Each

Each

Each

Repair Time:

Repair Time by Damage State:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Best fit mean:

1.10E-01

7.72E-01

1.88E+00

1.99E+00

4.08E+00

8.49E+00

1.39E+01

2.53E+01

3.76E+01

Best Fit Distribution:

7.72E-01

LogNormal

4.08E+00

LogNormal

2.53E+01

Normal

Quantity Plateau (Min Qty, Max Qty)

5.00

10.00

5.00

10.00

5.00

10.00

Average Repair Time (Min Qty, Max Qty)

1.54E+00

4.63E-01

8.16E+00

2.45E+00

5.06E+01

1.52E+01

CV or beta (Min Qty, Max Qty)

0.84

0.84

0.62

0.62

0.44

0.44

Quantity Unit:

Each

Each

Each

Environmental Impacts:

Embodied Carbon (kg CO₂eq)

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

1.4E+02

LogNormal

0.84

7.3E+02

LogNormal

0.62

2.6E+04

Normal

0.44

3.2E+03

LogNormal

0.84

2.1E+04

LogNormal

0.62

3.5E+05

Normal

0.44

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

NO

NO

NO

Casualty-affected Planar Area (sf) per Normative Unit:

Not Applicable

Not Applicable

Not Applicable

Serious Injury (Median, Dispersion)

0%

0.00

0%

0.00

0%

0.00

Loss of Life (Median, Dispersion)

0%

0.00

0%

0.00

0%

0.00

Post-event Tagging Flag:

NO

NO

YES

Unsafe Placard Trigger (Median, Dispersion)

0%

0.00

0%

0.00

75%

0.50

Comments:

demand and dispersion values listed are from a best fit approximation of the data performed by MKA.

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

None

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

C2011.021a

NISTIR Name
Description

Monolithic cast-in-place and precast concrete stairs with seismic joints that accommodate drift - replace in kind if replacement is required.
Cast in place concrete stair, with seismic interstory drift joint

Line 365

Construction Quality:	Normal			
Seismic Installation Conditions:	All			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Story Drift Ratio Unit less			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Local concrete cracking, localized concrete spalling	Extensive concrete cracking, concrete crushing	Loss of live load capacity.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?	FLR	
Demand Location (floor above?)	No	

Illustrations

				
C2011.011a-DS1-1.jpg	C2011.011a-DS2-1.jpg	C2011.011a-DS2-1.jpg		
1.00	1.00	1.00		

Damage State Probability:				
Fragility Parameters				
Median Demand, δ :	By User	By User	By User	
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified	
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified	
Total Dispersion, β :	By User	By User	By User	
Correlation (Yes / No)	NO	Data Quality Marginal	Documentation Quality Average	
Directionality (Yes / No)	YES	Data Relevance Marginal	Rationality Not Rated	

Consequence Functions

Repair Description

Protect surrounding space, epoxy inject cracks, repair finishes. Modify or relocate mechanical and electrical as required for repair work. Repair finishes.

Protect floor, cut out damaged areas, repair buckled rebar, patch / cast concrete, repair finishes. Modify or relocate mechanical and electrical as required for repair work. Repair finishes.

Protect area, remove damaged stair including landings and handrails. Remove and reinstall damaged soffit and mechanical systems. Replace stair, landings, and handrail. Modify or relocate mechanical and electrical as required for repair work. Repair finishes.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.00E+02	7.00E+02	1.70E+03	1.80E+03	3.70E+03	7.70E+03	1.44E+04	2.50E+04	3.67E+04						
Best fit mean:	6.14E+02			3.71E+03			2.53E+04								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00								
Average Repair Cost (Min Qty, Max Qty)	9.10E+02 5.60E+02			4.44E+03 3.15E+03			2.99E+04 2.12E+04								
CV or beta (Min Qty, Max Qty)	0.80 0.80			0.57 0.57			0.34 0.34								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.10E-01	7.72E-01	1.88E+00	1.99E+00	4.08E+00	8.49E+00	1.59E+01	2.75E+01	4.05E+01						
Best fit mean:	7.72E-01			4.08E+00			2.75E+01								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00								
Average Repair Time (Min Qty, Max Qty)	1.00E+00 6.18E-01			4.90E+00 3.47E+00			3.30E+01 2.34E+01								
CV or beta (Min Qty, Max Qty)	0.84 0.84			0.62 0.62			0.42 0.42								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.4E+02	LogNormal	0.84	7.3E+02	LogNormal	0.62	2.8E+04	Normal	0.42						
Embodied Energy (MJ)	3.2E+03	LogNormal	0.84	2.1E+04	LogNormal	0.62	3.9E+05	Normal	0.42						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			75% 0.50								

Comments: User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Date Created: Not Given Root Cost Multiplier: 1

Approved (YES / NO)? By User Date Generated: 02/26/19

Official (YES / NO) ? By User

Author: Not Given

Revisions: None

FEMA P-58 Fragility Specification

NISTIR Classification C2011.021b
NISTIR Name Monolithic cast-in-place and precast concrete stairs with no seismic joints - replace in kind if replacement is required.
Description Cast in place concrete stair, no seismic interstory drift joint

Line 366

Construction Quality:	Normal			
Seismic Installation Conditions:	All			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Story Drift Ratio Unit less			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1.DS2.DS3)			
Descriptions	Local concrete cracking, localized concrete spalling	Extensive concrete cracking, concrete crushing	Loss of live load capacity.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?	FLR	
Demand Location (floor above?)	No	

Illustrations

				
C2011.011a-DS1-1.jpg	C2011.011a-DS2-1.jpg	C2011.011a-DS2-1.jpg		
1.00	1.00	1.00		

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	By User	By User	By User	
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified	
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified	
Total Dispersion, β :	By User	By User	By User	
Correlation (Yes / No)	NO	Data Quality Marginal	Documentation Quality Average	
Directionality (Yes / No)	YES	Data Relevance Marginal	Rationality Not Rated	

Consequence Functions

Repair Description	Protect surrounding space, epoxy inject cracks, repair finishes. Modify or relocate mechanical and electrical as required for repair work. Repair finishes.	Protect floor, cut out damaged areas, repair buckled rebar, patch / cast concrete, repair finishes. Modify or relocate mechanical and electrical as required for repair work. Repair finishes.	Protect area, remove damaged stair including landings and handrails. Remove and reinstall damaged soffit and mechanical systems. Replace stair, landings, and handrail. Modify or relocate mechanical and electrical as required for repair work. Repair finishes.
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Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.00E+02	7.00E+02	1.70E+03	1.80E+03	3.70E+03	7.70E+03	1.44E+04	2.50E+04	3.67E+04						
Best fit mean:	6.14E+02			3.71E+03			2.53E+04								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00								
Average Repair Cost (Min Qty, Max Qty)	8.40E+02 5.60E+02			4.44E+03 2.96E+03			2.99E+04 2.00E+04								
CV or beta (Min Qty, Max Qty)	0.80 0.80			0.57 0.57			0.34 0.34								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.10E-01	7.72E-01	1.88E+00	1.99E+00	4.08E+00	8.49E+00	1.59E+01	2.75E+01	4.05E+01						
Best fit mean:	7.72E-01			4.08E+00			2.75E+01								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00								
Average Repair Time (Min Qty, Max Qty)	9.27E-01 6.18E-01			4.90E+00 3.26E+00			3.30E+01 2.20E+01								
CV or beta (Min Qty, Max Qty)	0.84 0.84			0.62 0.62			0.42 0.42								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.4E+02	LogNormal	0.84	7.3E+02	LogNormal	0.62	2.8E+04	Normal	0.42						
Embodied Energy (MJ)	3.2E+03	LogNormal	0.84	2.1E+04	LogNormal	0.62	3.9E+05	Normal	0.42						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			75% 0.50								

Comments: User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: None
Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

C2011.021c

NISTIR Name
Description

Monolithic cast-in-place and precast concrete stairs with seismic joints that accommodate drift - replace with prefabricated steel stair if replacement is required.
Cast in place concrete stair, with seismic interstory drift joint

Line 367

Construction Quality: Normal
Seismic Installation Conditions: All

Fragility Unit of Measure:	EA 1
Demand Parameter (unit):	Story Drift Ratio
Number of Damage States:	3

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?	FLR	
Demand Location (floor above?)	No	

Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Local concrete cracking, localized concrete spalling	Extensive concrete cracking, concrete crushing	Loss of live load capacity.		

Illustrations

				
C2011.011a-DS1-1.jpg	C2011.011a-DS2-1.jpg	C2011.011a-DS2-1.jpg		
1.00	1.00	1.00		

Damage State Probability:

Fragility Parameters					
Median Demand, δ :	By User	By User	By User		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified		
Total Dispersion, β :	By User	By User	By User		

Correlation (Yes / No) NO
Directionality (Yes / No) YES
Data Quality Marginal
Data Relevance Marginal
Documentation Quality Average
Rationality Not Rated

Consequence Functions
Repair Description

Protect surrounding space, epoxy inject cracks, repair finishes. Modify or relocate mechanical and electrical as required for repair work. Repair finishes.

Protect floor, cut out damaged areas, repair buckled rebar, patch / cast concrete, repair finishes. Modify or relocate mechanical and electrical as required for repair work. Repair finishes.

Protect area, remove damaged stair including landings and handrails. Remove and reinstall damaged soffit and mechanical systems. Replace stair, landings, and handrail. Modify or relocate mechanical and electrical as required for repair work. Repair finishes.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.00E+02	7.00E+02	1.70E+03	1.80E+03	3.70E+03	7.70E+03	1.44E+04	2.50E+04	3.67E+04						
Best fit mean:	6.14E+02			3.71E+03			2.53E+04								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00								
Average Repair Cost (Min Qty, Max Qty)	9.10E+02 5.60E+02			4.44E+03 3.15E+03			2.99E+04 2.12E+04								
CV or beta (Min Qty, Max Qty)	0.80 0.80			0.57 0.57			0.34 0.34								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.10E-01	7.72E-01	1.88E+00	1.99E+00	4.08E+00	8.49E+00	1.59E+01	2.75E+01	4.05E+01						
Best fit mean:	7.72E-01			4.08E+00			2.75E+01								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00								
Average Repair Time (Min Qty, Max Qty)	1.00E+00 6.18E-01			4.90E+00 3.47E+00			3.30E+01 2.34E+01								
CV or beta (Min Qty, Max Qty)	0.84 0.84			0.62 0.62			0.42 0.42								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.4E+02	LogNormal	0.84	7.3E+02	LogNormal	0.62	2.8E+04	Normal	0.42						
Embodied Energy (MJ)	3.2E+03	LogNormal	0.84	2.1E+04	LogNormal	0.62	3.9E+05	Normal	0.42						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			75% 0.50								

Comments: User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: None
Root Cost Multiplier: 1
Date Generated: 02/26/19

Line 368

Monolithic cast-in-place and precast concrete stairs with no seismic joints - replace with prefabricated steel stair if replacement is required.
Cast in place concrete stair, no seismic interstory drift joint

All

EA 1

Story

3

--	--

Sequential

$$\text{Seq}(\text{DS1}, \text{DS2}, \text{DS3})$$

Local concrete cracking, localized

concrete spalling

--	--

load capacity.

Quantity rounding	Round qty	YES
Allow sum by floor or building?	FLR	

Demand Location (floor above?) No

Illustrations



C2011.011a-L
1.00

	1.00
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By User

	By User	Not Specified
Number of users	100	100
Number of sessions	100	100
Number of requests	100	100
Number of errors	100	100
Number of timeouts	100	100
Number of failures	100	100
Number of warnings	100	100
Number of messages	100	100
Number of events	100	100
Number of exceptions	100	100
Number of logs	100	100
Number of alerts	100	100
Number of notifications	100	100
Number of reports	100	100
Number of dashboards	100	100
Number of widgets	100	100
Number of filters	100	100
Number of views	100	100
Number of pages	100	100
Number of links	100	100
Number of menus	100	100
Number of settings	100	100
Number of preferences	100	100
Number of profiles	100	100
Number of roles	100	100
Number of permissions	100	100
Number of policies	100	100
Number of rules	100	100
Number of conditions	100	100
Number of actions	100	100
Number of triggers	100	100
Number of handlers	100	100
Number of processors	100	100
Number of executors	100	100
Number of schedulers	100	100
Number of managers	100	100
Number of controllers	100	100
Number of services	100	100
Number of providers	100	100
Number of adapters	100	100
Number of connectors	100	100
Number of interfaces	100	100
Number of protocols	100	100
Number of standards	100	100
Number of formats	100	100
Number of languages	100	100
Number of scripts	100	100
Number of templates	100	100
Number of stylesheets	100	100
Number of fonts	100	100
Number of colors	100	100
Number of sounds	100	100
Number of images	100	100
Number of videos	100	100
Number of documents	100	100
Number of files	100	100
Number of folders	100	100
Number of drives	100	100
Number of networks	100	100
Number of servers	100	100
Number of clients	100	100
Number of devices	100	100
Number of components	100	100
Number of modules	100	100
Number of packages	100	100
Number of libraries	100	100
Number of frameworks	100	100
Number of tools	100	100
Number of utilities	100	100
Number of plugins	100	100
Number of extensions	100	100
Number of add-ons	100	100
Number of updates	100	100
Number of patches	100	100
Number of releases	100	100
Number of versions	100	100
Number of builds	100	100
Number of distributions	100	100
Number of installations	100	100
Number of configurations	100	100
Number of setups	100	100
Number of deployments	100	100
Number of migrations	100	100
Number of upgrades	100	100
Number of downgrades	100	100
Number of rollbacks	100	100
Number of backups	100	100
Number of restores	100	100
Number of exports	100	100
Number of imports	100	100
Number of transfers	100	100
Number of moves	100	100
Number of copies	100	100
Number of deletions	100	100
Number of creations	100	100
Number of modifications	100	100
Number of updates	100	100
Number of changes	100	100
Number of revisions	100	100
Number of iterations	100	100
Number of cycles	100	100
Number of loops	100	100
Number of branches	100	100
Number of merges	100	100
Number of commits	100	100
Number of pulls	100	100
Number of pushes	100	100
Number of clones	100	100
Number of forks	100	100
Number of joins	100	100
Number of splits	100	100
Number of unions	100	100
Number of intersections	100	100
Number of differences	100	100
Number of similarities	100	100
Number of contrasts	100	100
Number of comparisons	100	100
Number of evaluations	100	100
Number of assessments	100	100
Number of analyses	100	100
Number of investigations	100	100
Number of examinations	100	100
Number of inspections	100	100
Number of audits	100	100
Number of reviews	100	100
Number of checks	100	100
Number of tests	100	100
Number of experiments	100	100
Number of trials	100	100
Number of runs	100	100
Number of executions	100	100
Number of performances	100	100
Number of presentations	100	100
Number of demonstrations	100	100
Number of exhibitions	100	100

Not Specified	Not Specified
---------------	---------------

Not Specified
By User

By User

NO

NO
YES

Data Quality Marginal

Data Relevance Marginal

Documentation Quality Average

Rationality Not Rated

Consequence Fund	Repair Description

Protect surrounding space, epoxy inject cracks, repair finishes. Modify or relocate mechanical and electrical as required for repair work. Repair finishes.

Protect floor, cut out damaged areas, repair buckled rebar, patch / cast concrete, repair finishes. Modify or relocate mechanical and electrical as required for repair work. Repair finishes.

NO

NO

NO

Repair Costs:

Repair Costs:	P ₁₀ P ₅₀ P ₉₀			P ₁₀ P ₅₀ P ₉₀			P ₁₀ P ₅₀ P ₉₀			P ₁₀ P ₅₀ P ₉₀			P ₁₀ P ₅₀ P ₉₀		
Repair Cost by Damage State:	1.00E+02	7.00E+02	1.70E+03	1.80E+03	3.70E+03	7.70E+03	1.44E+04	2.50E+04	3.67E+04						
Best fit mean:	6.14E+02			3.71E+03			2.53E+04								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00	10.00		3.00	10.00		3.00	10.00							
Average Repair Cost (Min Qty, Max Qty)	8.40E+02	5.60E+02		4.44E+03	2.96E+03		2.99E+04	2.00E+04							
CV or beta (Min Qty, Max Qty)	0.80	0.80		0.57	0.57		0.34	0.34							
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.10E-01	7.72E-01	1.88E+00	1.99E+00	4.08E+00	8.49E+00	1.59E+01	2.75E+01	4.05E+01						
Best fit mean:	7.72E-01			4.08E+00			2.75E+01								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00	10.00		3.00	10.00		3.00	10.00							
Average Repair Time (Min Qty, Max Qty)	9.27E-01	6.18E-01		4.90E+00	3.26E+00		3.30E+01	2.20E+01							
CV or beta (Min Qty, Max Qty)	0.84	0.84		0.62	0.62		0.42	0.42							
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.4E+02	LogNormal	0.84	7.3E+02	LogNormal	0.62	2.8E+04	Normal	0.42						
Embodied Energy (MJ)	3.2E+03	LogNormal	0.84	2.1E+04	LogNormal	0.62	3.9E+05	Normal	0.42						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		75%	0.50							

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component

User to pro
Not Given

By User

By User
By User

Not Given

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

C2011.031a

NISTIR Name
Description

Hybrid stair assembly with steel stringers and concrete treads and landings with seismic joints that accommodate drift.
Stair consists of steel stringers with precast treads rigidly linked to stringer

Line 369

Construction Quality:	Normal				
Seismic Installation Conditions:	All				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio Unit less				
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Localized steel yielding.	Buckling of steel, weld cracking.	Loss of live load capacity.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?	FLR	
Demand Location (floor above?)	No	

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	By User	By User	By User		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified		
Total Dispersion, β :	By User	By User	By User		
Correlation (Yes / No)	NO	Data Quality Marginal	Documentation Quality Average		
Directionality (Yes / No)	YES	Data Relevance Marginal	Rationality Not Rated		

Consequence Functions

Repair Description

Protect surrounding space. Minor repair of finishes. Modify or relocate mechanical and electrical as required for repair work. Repair finishes.

Protect floor, cut out damaged areas, reweld. Repair finishes. Modify or relocate mechanical and electrical as required for repair work. Repair finishes.

Protect area, remove damaged stair including landings and handrails. Remove and reinstall damaged soffit and mechanical systems. Replace stair, landings, and handrail. Modify or relocate mechanical and electrical as required for repair work. Repair finishes.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.00E+02	4.00E+02	1.40E+03	1.30E+03	2.70E+03	5.70E+03	1.08E+04	2.10E+04	3.15E+04						
Best fit mean:	3.94E+02			2.71E+03			2.11E+04								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00								
Average Repair Cost (Min Qty, Max Qty)	4.80E+02 3.20E+02			3.24E+03 2.16E+03			2.51E+04 1.68E+04								
CV or beta (Min Qty, Max Qty)	0.99 0.99			0.58 0.58			0.38 0.38								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.10E-01	4.41E-01	1.54E+00	1.43E+00	2.98E+00	6.29E+00	1.19E+01	2.31E+01	3.47E+01						
Best fit mean:	4.41E-01			2.98E+00			2.31E+01								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00								
Average Repair Time (Min Qty, Max Qty)	5.29E-01 3.53E-01			3.57E+00 2.38E+00			2.77E+01 1.85E+01								
CV or beta (Min Qty, Max Qty)	1.02 1.02			0.63 0.63			0.46 0.46								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.0E+01	LogNormal	1.02	3.4E+02	LogNormal	0.63	2.4E+04	Normal	0.46						
Embodied Energy (MJ)	9.4E+02	LogNormal	1.02	8.7E+03	LogNormal	0.63	3.2E+05	Normal	0.46						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		75%	0.50							

Comments: User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Date Created: Not Given Root Cost Multiplier: 1

Approved (YES / NO)? By User Date Generated: 02/26/19

Official (YES / NO) ? By User

Author: Not Given

Revisions: None

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

C2011.031b

Hybrid stair assembly with steel stringers and concrete treads and landings with no seismic joints.

Stair consists of steel stringers with precast treads rigidly linked to stringer

Line 370

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

All

EA 1

Story Drift Ratio

3

DS1

Sequential

Seq(DS1,DS2,DS3)

Localized steel yielding.

DS2

Sequential

Buckling of steel, weld cracking.

DS3

Sequential

Loss of live load capacity.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

FLR

Demand Location (floor above?)

No

Illustrations

none

1.00

none

1.00

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.005

Not Specified

Not Specified

0.6

NO

YES

Data Quality

Data Relevance

Marginal

Marginal

Documentation Quality

Average

Rationality

Not Rated

Consequence Functions

Repair Description

Protect surrounding space. Minor repair of finishes. Modify or relocate mechanical and electrical as required for repair work. Repair finishes.

Protect floor, cut out damaged areas, reweld. Repair finishes. Modify or relocate mechanical and electrical as required for repair work. Repair finishes.

Protect area, remove damaged stair including landings and handrails. Remove and reinstall damaged soffit and mechanical systems. Replace stair, landings, and handrail. Modify or relocate mechanical and electrical as required for repair work. Repair finishes.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.00E+02

4.00E+02

1.40E+03

3.94E+02

LogNormal

3.00

10.00

4.80E+02

3.20E+02

0.99

0.99

Each

P₁₀

P₅₀

P₉₀

1.30E+03

2.70E+03

5.70E+03

2.71E+03

LogNormal

3.00

10.00

3.24E+03

2.16E+03

0.58

0.58

Each

P₁₀

P₅₀

P₉₀

1.08E+04

2.10E+04

3.15E+04

2.11E+04

Normal

3.00

10.00

2.51E+04

1.68E+04

0.38

0.38

Each

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

9.26E-02

3.71E-01

1.30E+00

3.71E-01

LogNormal

3.00

10.00

4.45E-01

2.96E-01

1.02

1.02

Each

P₁₀

P₅₀

P₉₀

1.20E+00

2.50E+00

5.28E+00

2.50E+00

LogNormal

3.00

10.00

3.00E+00

2.00E+00

0.63

0.63

Each

P₁₀

P₅₀

P₉₀

1.00E+01

1.94E+01

2.92E+01

1.94E+01

Normal

3.00

10.00

2.33E+01

1.55E+01

0.46

0.46

Each

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

4.0E+01

LogNormal

1.02

3.4E+02

LogNormal

0.63

2.4E+04

Normal

0.46

Median Cost

Best Fit

CV or Beta

9.4E+02

LogNormal

1.02

8.7E+03

LogNormal

0.63

3.2E+05

Normal

0.46

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

75%

0.50

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

C3011.001a

NISTIR Name
Description

Wall Partition, Type: Gypsum + Wallpaper, Full Height, Fixed Below, Fixed Above
Costing based upon 9'x100' Panels

Line 371

Construction Quality:	Normal				
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	LF 100				
Demand Parameter (unit):	Story Drift Ratio	Unit less			
Number of Damage States:	1				
Damage State:	DS1				
Type of Damage State:	Sequential				
DS Hierarchy	Seq(DS1)				
Descriptions	Wall paper warped and torn.				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	NO	

Illustrations

none				
1.00				

Damage State Probability:					
Fragility Parameters					
Median Demand, δ :	0.0021				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	Not Specified				
Total Dispersion, β :	0.6				
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Superior		Rationality Not Rated	

Consequence Functions
Repair Description

Remove existing wall paper (or wall) and install new wall paper for full 100 foot length of wall. Existing wall damage per wall type NISTIR file.

Long Lead Time (Yes / No)

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.40E+03	2.70E+03	3.50E+03												
Best fit mean:	2.83E+03														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		3.00												
Average Repair Cost (Min Qty, Max Qty)	3.24E+03		2.16E+03												
CV or beta (Min Qty, Max Qty)	0.15		0.15												
Quantity Unit:	Each (9'x100' Panel)														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.25E+00	2.52E+00	3.24E+00												
Best fit mean:	2.52E+00														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		3.00												
Average Repair Time (Min Qty, Max Qty)	3.02E+00		2.02E+00												
CV or beta (Min Qty, Max Qty)	0.29		0.29												
Quantity Unit:	Each (9'x100' Panel)														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	7.6E+02	LogNormal	0.29												
Embodied Energy (MJ)	1.8E+04	LogNormal	0.29												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: None

Root Cost Multiplier: 900
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

C3011.001b
Wall Partition, Type: Gypsum + Wallpaper, Partial Height, Fixed Below, Lateral Braced Above
Costing based upon 9'x100' Panels

Line 372

Construction Quality: Normal

Seismic Installation Conditions: Not Specified

Fragility Unit of Measure: LF 100

Demand Parameter (unit): Story Drift Ratio Unit less

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy: Seq(DS1)

Descriptions: Wall paper warped and torn.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

NO

Illustrations

Damage State Probability:

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

0.0064

Not Specified

Not Specified

0.3

Correlation (Yes / No)

NO

Data Quality

Superior

Documentation Quality

Superior

Directionality (Yes / No)

YES

Data Relevance

Superior

Rationality

Not Rated

Consequence Functions

Repair Description

Remove existing wall paper (or wall) and install new wall paper for full 100 foot length of wall. Existing wall damage per wall type NISTIR file.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.40E+03	2.70E+03	3.50E+03												
Best fit mean:	2.83E+03														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		3.00												
Average Repair Cost (Min Qty, Max Qty)	3.24E+03		2.16E+03												
CV or beta (Min Qty, Max Qty)	0.15		0.15												
Quantity Unit:	Each (9'x100' Panel)														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.25E+00	2.52E+00	3.24E+00												
Best fit mean:	2.52E+00														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		3.00												
Average Repair Time (Min Qty, Max Qty)	3.02E+00		2.02E+00												
CV or beta (Min Qty, Max Qty)	0.29		0.29												
Quantity Unit:	Each (9'x100' Panel)														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	7.6E+02	LogNormal	0.29												
Embodied Energy (MJ)	1.8E+04	LogNormal	0.29												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments: None

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Not Given

Revisions: None

Root Cost Multiplier: 900

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

C3011.001c

NISTIR Name

Wall Partition, Type: Gypsum + Wallpaper, Full Height, Fixed Below, Slip Track Above w/ returns (friction connection)

Description

Costing based upon 9'x100' Panels

Line 373

Construction Quality:

Normal

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

LF 100

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	NO	

Number of Damage States:

1

Damage State:

DS1

Type of Damage State:

Sequential

DS Hierarchy

Seq(DS1)

Descriptions

Wall paper warped and torn.

Illustrations

none				
1.00				

Damage State Probability:

Fragility Parameters

Median Demand, θ :

0.002

Data dispersion, β_d :

Not Specified

Uncertainty, β_u :

Not Specified

Total Dispersion, β_t :

0.7

Correlation (Yes / No)

NO

Directionality (Yes / No)

YES

Data Quality Superior

Data Relevance Superior

Documentation Quality Superior

Rationality Not Rated

Consequence Functions

Repair Description

Remove existing wall paper (or wall) and install new wall paper for full 100 foot length of wall. Existing wall damage per wall type NISTIR file.

Long Lead Time (Yes / No)

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.40E+03	2.70E+03	3.50E+03												
Best fit mean:	2.83E+03														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		3.00												
Average Repair Cost (Min Qty, Max Qty)	3.24E+03		2.16E+03												
CV or beta (Min Qty, Max Qty)	0.15		0.15												
Quantity Unit:	Each (9'x100' Panel)														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.25E+00	2.52E+00	3.24E+00												
Best fit mean:	2.52E+00														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		3.00												
Average Repair Time (Min Qty, Max Qty)	3.02E+00		2.02E+00												
CV or beta (Min Qty, Max Qty)	0.29		0.29												
Quantity Unit:	Each (9'x100' Panel)														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	7.6E+02	LogNormal	0.29												
Embodied Energy (MJ)	1.8E+04	LogNormal	0.29												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%		0.00												
Loss of Life (Median, Dispersion)	0%		0.00												
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00												

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

None

Root Cost Multiplier: 900

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

C3011.001d

NISTIR Name
Description

Wall Partition, Type: Gypsum + Wallpaper, Full Height, Fixed Below, Slip Track Above w/o returns (friction connection)
Costing based upon 9'x100' Panels

Line 374

Construction Quality:		Normal			
Seismic Installation Conditions:		Not Specified			
Fragility Unit of Measure:		LF 100			
Demand Parameter (unit):		Story Drift Ratio		Unit less	
Number of Damage States:		1			
Damage State:		DS1			
Type of Damage State:		Sequential			
DS Hierarchy		Seq(DS1)			
Descriptions		Wall paper warped and torn.			

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	NO	

Illustrations

none				
1.00				

Damage State Probability:					
Fragility Parameters					
Median Demand, δ :	0.0035				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	Not Specified				
Total Dispersion, β :	0.7				
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Superior		Rationality Not Rated	

Consequence Functions
Repair Description

Remove existing wall paper (or wall) and install new wall paper for full 100 foot length of wall. Existing wall damage per wall type NISTIR file.

Long Lead Time (Yes / No)

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.40E+03	2.70E+03	3.50E+03												
Best fit mean:	2.83E+03														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		3.00												
Average Repair Cost (Min Qty, Max Qty)	3.24E+03		2.16E+03												
CV or beta (Min Qty, Max Qty)	0.15		0.15												
Quantity Unit:	Each (9'x100' Panel)														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.25E+00	2.52E+00	3.24E+00												
Best fit mean:	2.52E+00														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		3.00												
Average Repair Time (Min Qty, Max Qty)	3.02E+00		2.02E+00												
CV or beta (Min Qty, Max Qty)	0.29		0.29												
Quantity Unit:	Each (9'x100' Panel)														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	7.6E+02	LogNormal	0.29												
Embodied Energy (MJ)	1.8E+04	LogNormal	0.29												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: None

Root Cost Multiplier: 900
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

C3011.002a

Wall Partition, Type: Gypsum + Ceramic Tile, Full Height, Fixed Below, Fixed Above

Costing based upon 9'x100' Panels

Line 375

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

Not Specified

LF 100

Story Drift Ratio

2

DS1

Sequential

Seq(DS1,DS2)

Minor cracked joints and tile.

DS2

Sequential

Not Specified

Cracked joints and tile.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

none

1.00

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.0021

Not Specified

Not Specified

0.6

0.0071

Not Specified

Not Specified

0.45

NO

YES

Data Quality

Superior

Data Relevance

Superior

Documentation Quality

Superior

Rationality

Not Rated

Consequence Functions

Repair Description

Carefully remove cracked tile and grout at cracked joints, install new ceramic tile and re-grout joints for 10% of full 100 foot length of wall. Existing wall board will remain in place.

Install ceramic tile and grout all joints for full 100 foot length of wall. Note: gypsum wall board will also be removed and replaced which means the removal of ceramic tile will be part of the gypsum wall board removal.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

5.00E+03

7.20E+03

9.00E+03

P₁₀

P₅₀

P₉₀

2.70E+04

2.92E+04

3.42E+04

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

7.07E+03

Normal

1.00

3.00

3.00E+04

LogNormal

1.00

3.00

6.66E+00

Normal

1.00

3.00

2.70E+01

LogNormal

1.00

3.00

8.64E+03

5.76E+03

0.22

0.22

3.50E+04

2.33E+04

0.09

0.09

Each (9'x100' Panel)

Each (9'x100' Panel)

P₁₀

P₅₀

P₉₀

4.59E+00

6.66E+00

8.37E+00

P₁₀

P₅₀

P₉₀

2.50E+01

2.70E+01

3.17E+01

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

6.66E+00

Normal

1.00

3.00

2.70E+01

LogNormal

1.00

3.00

7.99E+00

5.33E+00

0.33

0.33

3.24E+01

2.16E+01

0.27

0.27

Each (9'x100' Panel)

Each (9'x100' Panel)

Median Cost

Best Fit

CV or Beta

7.3E+02

Normal

0.33

Median Cost

Best Fit

CV or Beta

1.4E+04

LogNormal

0.27

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

1.7E+04

Normal

0.33

3.5E+05

LogNormal

0.27

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

NO

NO

0%

0.00

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

900

02/26/19

FEMA P-58 Fragility Specification

NISTIR ClassificationC3011.002b

NISTIR NameDescription

Wall Partition, Type: Gypsum + Ceramic Tile, Partial Height, Fixed Below, Lateral Braced Above

Costing based upon 9'x100' Panels

Line 376

Construction Quality:	Normal				
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	LF 100				
Demand Parameter (unit):	Story Drift Ratio				
Number of Damage States:	2				
Damage State:	DS1	DS2			
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Minor cracked joints and tile.		Cracked joints and tile.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

none	none			
1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.0064	0.011			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.3	0.3			
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Superior		Rationality Not Rated	

Consequence Functions
Repair Description

Carefully remove cracked tile and grout at cracked joints, install new ceramic tile and re-grout joints for 10% of full 100 foot length of wall. Existing wall board will remain in place.

Install ceramic tile and grout all joints for full 100 foot length of wall. Note: gypsum wall board will also be removed and replaced which means the removal of ceramic tile will be part of the gypsum wall board removal.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	5.00E+03	7.20E+03	9.00E+03	2.70E+04	2.92E+04	3.42E+04									
Best fit mean:	7.07E+03			3.00E+04											
Best Fit Distribution:	Normal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00			1.00	3.00										
Average Repair Cost (Min Qty, Max Qty)	8.64E+03			3.50E+04	2.33E+04										
CV or beta (Min Qty, Max Qty)	0.22			0.09	0.09										
Quantity Unit:	Each (9'x100' Panel)			Each (9'x100' Panel)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	4.59E+00	6.66E+00	8.37E+00	2.50E+01	2.70E+01	3.17E+01									
Best fit mean:	6.66E+00			2.70E+01											
Best Fit Distribution:	Normal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00			1.00	3.00										
Average Repair Time (Min Qty, Max Qty)	7.99E+00			3.24E+01	2.16E+01										
CV or beta (Min Qty, Max Qty)	0.33			0.27	0.27										
Quantity Unit:	Each (9'x100' Panel)			Each (9'x100' Panel)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	7.3E+02	Normal	0.33	1.4E+04	LogNormal	0.27									
Embodied Energy (MJ)	1.7E+04	Normal	0.33	3.5E+05	LogNormal	0.27									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier: 900

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

C3011.002c

NISTIR Name
Description

Wall Partition, Type: Gypsum + Ceramic Tile, Full Height, Fixed Below, Slip Track Above w/ returns (friction connection)
Costing based upon 9'x100' Panels

Line 377

Construction Quality:	Normal				
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	LF 100				
Demand Parameter (unit):	Story Drift Ratio Unit less				
Number of Damage States:	2				
Damage State:	DS1		DS2		
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Minor cracked joints and tile.		Cracked joints and tile.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

none	none			
1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.002	0.005			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.7	0.4			
Correlation (Yes / No)	NO		Data Quality Superior	Documentation Quality Superior	
Directionality (Yes / No)	YES		Data Relevance Superior	Rationality Not Rated	

Consequence Functions
Repair Description

Carefully remove cracked tile and grout at cracked joints, install new ceramic tile and re-grout joints for 10% of full 100 foot length of wall. Existing wall board will remain in place.

Install ceramic tile and grout all joints for full 100 foot length of wall. Note: gypsum wall board will also be removed and replaced which means the removal of ceramic tile will be part of the gypsum wall board removal.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	5.00E+03	7.20E+03	9.00E+03	2.70E+04	2.92E+04	3.42E+04									
Best fit mean:	7.07E+03			3.00E+04											
Best Fit Distribution:	Normal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00			1.00	3.00										
Average Repair Cost (Min Qty, Max Qty)	8.64E+03			3.50E+04	2.33E+04										
CV or beta (Min Qty, Max Qty)	0.22			0.09	0.09										
Quantity Unit:	Each (9'x100' Panel)			Each (9'x100' Panel)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	4.59E+00	6.66E+00	8.37E+00	2.50E+01	2.70E+01	3.17E+01									
Best fit mean:	6.66E+00			2.70E+01											
Best Fit Distribution:	Normal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00			1.00	3.00										
Average Repair Time (Min Qty, Max Qty)	7.99E+00			3.24E+01	2.16E+01										
CV or beta (Min Qty, Max Qty)	0.33			0.27	0.27										
Quantity Unit:	Each (9'x100' Panel)			Each (9'x100' Panel)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	7.3E+02	Normal	0.33	1.4E+04	LogNormal	0.27									
Embodied Energy (MJ)	1.7E+04	Normal	0.33	3.5E+05	LogNormal	0.27									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: None

Root Cost Multiplier: 900
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

C3011.002d
Wall Partition, Type: Gypsum + Ceramic Tile, Full Height, Fixed Below, Slip Track Above w/o returns (friction connection)
Costing based upon 9'x100' Panels

Line 378

Construction Quality:	Normal				
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	LF 100				
Demand Parameter (unit):	Story Drift Ratio				
Number of Damage States:	2				
Damage State:	DS1		DS2		
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Minor cracked joints and tile.		Cracked joints and tile.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

none	none			
1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.0035	0.0093			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.7	0.45			
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Superior		Rationality Not Rated	

Consequence Functions
Repair Description

Carefully remove cracked tile and grout at cracked joints, install new ceramic tile and re-grout joints for 10% of full 100 foot length of wall. Existing wall board will remain in place.

Install ceramic tile and grout all joints for full 100 foot length of wall. Note: gypsum wall board will also be removed and replaced which means the removal of ceramic tile will be part of the gypsum wall board removal.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	5.00E+03	7.20E+03	9.00E+03	2.70E+04	2.92E+04	3.42E+04									
Best fit mean:	7.07E+03			3.00E+04											
Best Fit Distribution:	Normal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00			1.00	3.00										
Average Repair Cost (Min Qty, Max Qty)	8.64E+03			3.50E+04	2.33E+04										
CV or beta (Min Qty, Max Qty)	0.22			0.09	0.09										
Quantity Unit:	Each (9'x100' Panel)			Each (9'x100' Panel)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	4.59E+00	6.66E+00	8.37E+00	2.50E+01	2.70E+01	3.17E+01									
Best fit mean:	6.66E+00			2.70E+01											
Best Fit Distribution:	Normal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00			1.00	3.00										
Average Repair Time (Min Qty, Max Qty)	7.99E+00			3.24E+01	2.16E+01										
CV or beta (Min Qty, Max Qty)	0.33			0.27	0.27										
Quantity Unit:	Each (9'x100' Panel)			Each (9'x100' Panel)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	7.3E+02	Normal	0.33	1.4E+04	LogNormal	0.27									
Embodied Energy (MJ)	1.7E+04	Normal	0.33	3.5E+05	LogNormal	0.27									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

900

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification C3011.003a

NISTIR Name Wall Partition, Type: High End Marble or Wood Panel, Full Height, Fixed Below, Fixed Above

Description Costing based upon 9'x100' Panels

Line 379

Construction Quality:	Normal					<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	LF 100					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	minor cracked joints and minor cracks in marble / wood paneling.		significant cracks in marble / wood paneling.			

Illustrations					
	none	none			
Damage State Probability:	1.00	1.00			

Fragility Parameters					
Median Demand, δ :	0.0021	0.0071			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.6	0.45			
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Superior		Rationality Not Rated	

Consequence Functions					
Repair Description	Carefully remove cracked marble/paneling and grout at cracked joints, and install new marble/paneling and re-grout joints for 10% of full 100 foot length of wall. Existing wall board will remain place.	Install new marble/paneling for full 100 foot length of wall. Note: the gypsum wall board will also be removed and replaced which means the removal of the marble/paneling will be part of the gypsum wall board removal.			

Long Lead Time (Yes / No)	NO			NO														
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀			
Repair Cost by Damage State:	1.20E+04	1.80E+04	2.40E+04	2.50E+04	4.50E+04	6.00E+04												
Best fit mean:	1.80E+04			4.33E+04														
Best Fit Distribution:	Normal			Normal														
Quantity Plateau (Min Qty, Max Qty)	1.00	3.00		1.00	3.00													
Average Repair Cost (Min Qty, Max Qty)	3.60E+04	1.08E+04		9.00E+04	2.70E+04													
CV or beta (Min Qty, Max Qty)	0.26	0.26		0.32	0.32													
Quantity Unit:	Each (9'x100' Panel)			Each (9'x100' Panel)														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀			
Repair Time by Damage State:	1.12E+01	1.67E+01	2.22E+01	2.31E+01	4.17E+01	5.56E+01												
Best fit mean:	1.67E+01			4.17E+01														
Best Fit Distribution:	Normal			Normal														
Quantity Plateau (Min Qty, Max Qty)	1.00	3.00		1.00	3.00													
Average Repair Time (Min Qty, Max Qty)	3.33E+01	9.98E+00		8.34E+01	2.50E+01													
CV or beta (Min Qty, Max Qty)	0.36	0.36		0.40	0.40													
Quantity Unit:	Each (9'x100' Panel)			Each (9'x100' Panel)														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta			
Embodied Carbon (kg CO2eq)	5.1E+03	Normal	0.36	1.9E+04	Normal	0.40												
Embodied Energy (MJ)	1.2E+05	Normal	0.36	4.5E+05	Normal	0.40												
LifeSafety Hazard:																		
Potential non-collapse casualties? (Yes / No)	NO			YES														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			100 SF														
Serious Injury (Median, Dispersion)	0%	0.00		10%	0.50													
Loss of Life (Median, Dispersion)	0%	0.00		5%	0.50													
Post-event Tagging Flag:	NO			YES														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		50%	0.50													

Comments: None

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Not Given

Revisions: None

Root Cost Multiplier: 900

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR ClassificationC3011.003b

NISTIR NameDescription

Wall Partition, Type: High End Marble or Wood Panel, Partial Height, Fixed Below, Lateral Braced Above

Costing based upon 9'x100' Panels

Line 380

Construction Quality:	Normal				<div>Quantity RoundingRound Qty?NO</div> <div>Allow sum by floor or building?NO</div> <div>Demand Location (floor above?)No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	LF 100				
Demand Parameter (unit):	Story Drift RatioUnit less				
Number of Damage States:	2				
Damage State:	DS1		DS2		
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	minor cracked joints and minor cracks in marble / wood paneling.		significant cracks in marble / wood paneling.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

none	none			
1.00	1.00			

Damage State Probability:				
Fragility Parameters				
Median Demand, δ :	0.0064	0.011		
Data dispersion, β_d :	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified		
Total Dispersion, β :	0.3	0.3		
Correlation (Yes / No)	NO	Data Quality Superior	Documentation Quality Superior	
Directionality (Yes / No)	YES	Data Relevance Superior	Rationality Not Rated	

Consequence Functions
Repair Description

Carefully remove cracked marble/paneling and grout at cracked joints, and install new marble/paneling and re-grout joints for 10% of full 100 foot length of wall. Existing wall board will remain place.

Install new marble/paneling for full 100 foot length of wall. Note: the gypsum wall board will also be removed and replaced which means the removal of the marble/paneling will be part of the gypsum wall board removal.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.20E+04	1.80E+04	2.40E+04	2.50E+04	4.50E+04	6.00E+04									
Best fit mean:	1.80E+04			4.33E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	1.00			1.00											
Average Repair Cost (Min Qty, Max Qty)	3.60E+04			9.00E+04											
CV or beta (Min Qty, Max Qty)	0.26			0.32											
Quantity Unit:	Each (9'x100' Panel)			Each (9'x100' Panel)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.12E+01	1.67E+01	2.22E+01	2.31E+01	4.17E+01	5.56E+01									
Best fit mean:	1.67E+01			4.17E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	1.00			1.00											
Average Repair Time (Min Qty, Max Qty)	3.33E+01			8.34E+01											
CV or beta (Min Qty, Max Qty)	0.36			0.40											
Quantity Unit:	Each (9'x100' Panel)			Each (9'x100' Panel)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	5.1E+03	Normal	0.36	1.9E+04	Normal	0.40									
Embodied Energy (MJ)	1.2E+05	Normal	0.36	4.5E+05	Normal	0.40									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			YES											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			100 SF											
Serious Injury (Median, Dispersion)	0%			10%											
Loss of Life (Median, Dispersion)	0%			5%											
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%			50%											

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier: 900

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

C3011.003c

NISTIR Name
Description

Wall Partition, Type: High End Marble or Wood Panel, Full Height, Fixed Below, Slip Track Above w/ returns (friction connection)
Costing based upon 9'x100' Panels

Line 381

Construction Quality:	Normal					<div>Quantity RoundingRound Qty? NO Allow sum by floor or building? NO Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	LF 100					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	minor cracked joints and minor cracks in marble / wood paneling.		significant cracks in marble / wood paneling.			

Illustrations

none	none			
1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.002	0.005			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.7	0.4			
Correlation (Yes / No)	NO		Data Quality Superior	Documentation Quality Superior	
Directionality (Yes / No)	YES		Data Relevance Superior	Rationality Not Rated	

Consequence Functions
Repair Description

Carefully remove cracked marble/paneling and grout at cracked joints, and install new marble/paneling and re-grout joints for 10% of full 100 foot length of wall. Existing wall board will remain place.

Install new marble/paneling for full 100 foot length of wall. Note: the gypsum wall board will also be removed and replaced which means the removal of the marble/paneling will be part of the gypsum wall board removal.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	
Repair Cost by Damage State:	1.20E+04	1.80E+04	2.40E+04	2.50E+04	4.50E+04	6.00E+04										
Best fit mean:	1.80E+04		4.33E+04													
Best Fit Distribution:	Normal		Normal													
Quantity Plateau (Min Qty, Max Qty)	1.00	3.00		1.00	3.00											
Average Repair Cost (Min Qty, Max Qty)	3.60E+04		1.08E+04		9.00E+04		2.70E+04									
CV or beta (Min Qty, Max Qty)	0.26		0.26		0.32		0.32									
Quantity Unit:	Each (9'x100' Panel)		Each (9'x100' Panel)		Each (9'x100' Panel)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	
Repair Time by Damage State:	1.12E+01	1.67E+01	2.22E+01	2.31E+01	4.17E+01	5.56E+01										
Best fit mean:	1.67E+01		4.17E+01													
Best Fit Distribution:	Normal		Normal													
Quantity Plateau (Min Qty, Max Qty)	1.00	3.00		1.00	3.00											
Average Repair Time (Min Qty, Max Qty)	3.33E+01		9.98E+00		8.34E+01		2.50E+01									
CV or beta (Min Qty, Max Qty)	0.36		0.36		0.40		0.40									
Quantity Unit:	Each (9'x100' Panel)		Each (9'x100' Panel)		Each (9'x100' Panel)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	
Embodied Carbon (kg CO2eq)	5.1E+03	Normal	0.36	1.9E+04	Normal	0.40										
Embodied Energy (MJ)	1.2E+05	Normal	0.36	4.5E+05	Normal	0.40										
LifeSafety Hazard:																
Potential non-collapse casualties? (Yes / No)	NO			YES												
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			100 SF												
Serious Injury (Median, Dispersion)	0%		0.00	10%		0.50			0.50			0.50			0.50	
Loss of Life (Median, Dispersion)	0%		0.00	5%		0.50			0.50			0.50			0.50	
Post-event Tagging Flag:	NO			YES												
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00	50%		0.50			0.50			0.50			0.50	

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: None

Root Cost Multiplier: 900
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

C3011.003d

Wall Partition, Type: High End Marble or Wood Panel, Full Height, Fixed Below, Slip Track Above w/o returns (friction connection)

Costing based upon 9'x100' Panels

Line 382

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

Not Specified

LF 100

Story Drift Ratio

2

DS1

Sequential

Seq(DS1,DS2)

minor cracked joints and minor cracks in marble / wood paneling.

significant cracks in marble / wood paneling.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

none

1.00

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

NO

YES

Data Quality

Data Relevance

Superior

Superior

Documentation Quality

Rationality

Superior

Not Rated

Consequence Functions

Repair Description

Carefully remove cracked marble/paneling and grout at cracked joints, and install new marble/paneling and re-grout joints for 10% of full 100 foot length of wall. Existing wall board will remain place.

Install new marble/paneling for full 100 foot length of wall. Note: the gypsum wall board will also be removed and replaced which means the removal of the marble/paneling will be part of the gypsum wall board removal.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.20E+04

1.80E+04

2.40E+04

2.50E+04

4.50E+04

6.00E+04

1.80E+04

Normal

3.00

1.00

3.00

3.60E+04

1.08E+04

9.00E+04

2.70E+04

0.26

0.26

0.32

0.32

Each (9'x100' Panel)

Each (9'x100' Panel)

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.12E+01

1.67E+01

2.22E+01

2.31E+01

4.17E+01

5.56E+01

1.67E+01

Normal

3.00

1.00

3.00

3.33E+01

9.98E+00

8.34E+01

2.50E+01

0.36

0.36

0.40

0.40

Each (9'x100' Panel)

Each (9'x100' Panel)

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

5.1E+03

Normal

0.36

1.9E+04

Normal

0.40

1.2E+05

Normal

0.36

4.5E+05

Normal

0.40

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

100 SF

0%

0.00

10%

0.50

0%

0.00

5%

0.50

NO

YES

0%

0.00

50%

0.50

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

900

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

C3021.001a

Line 383

NISTIR Name

Generic Floor Covering - Flooding of floor caused by failure of pipe - Office - Dry

Description

The user needs to review the fragilities of all piping modeled in the ceiling of the floor and input the peak floor acceleration value for the pipe with the lowest median peak floor acceleration value, along with the associated total dispersion (beta). Flooring type assumed to be carpet or vinyl. Available costs are per one square foot of floor area.

Construction Quality:

Normal

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

By User

Demand Parameter (unit):

Peak Floor Acceleration g

Number of Damage States:

1

Damage State:

DS1

Type of Damage State:

Sequential

DS Hierarchy

Seq(DS1)

Descriptions

Flooding of all or a portion of the total floor associated with a major leakage of a pipe.

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations

none				
1.00				

Damage State Probability:

Fragility Parameters

Median Demand, θ :

By User

Data dispersion, β_d :

Not Specified

Uncertainty, β_u :

Not Specified

Total Dispersion, β :

By User

Correlation (Yes / No)

NO

Directionality (Yes / No)

NO

Data Quality Not Rated

Data Relevance Not Rated

Documentation Quality Not Rated

Rationality Not Rated

Consequence Functions

Repair Description

Replace or dry out of the affected flooring materials, equipment and contents. Remove areas that could be affected by mold. Potentially considerable downtime. Cleanup and replacement of all water damaged items on floor. User must establish area of floor with flooding. Default recommendation is flooding of total floor area. Damage to unit floor area shall be entered to consequence which is multiplied by PACT "Fragility Unit of Measure".

Long Lead Time (Yes / No)

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.84E+01	3.10E+01	4.03E+01												
Best fit mean:	2.99E+01														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	500.00 2000.00														
Average Repair Cost (Min Qty, Max Qty)	6.21E+01 1.86E+01														
CV or beta (Min Qty, Max Qty)	0.28 0.28														
Quantity Unit:	Each (1'x1')														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.71E-02	2.88E-02	3.73E-02												
Best fit mean:	2.88E-02														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	500.00 2000.00														
Average Repair Time (Min Qty, Max Qty)	5.76E-02 1.73E-02														
CV or beta (Min Qty, Max Qty)	0.38 0.38														
Quantity Unit:	Each (1'x1')														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.0E+01	Normal	0.38												
Embodied Energy (MJ)	1.6E+02	Normal	0.38												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2015-07-28 User must replace median and total dispersion (beta) associated with fragility of major piping. Made consequence generic for user specification according to particulars of structure.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

C3021.001b

Line 384

NISTIR Name
Description

Generic Floor Covering - Flooding of floor caused by failure of pipe - Office - Humid
The user needs to review the fragilities of all piping modeled in the ceiling of the floor and input the peak floor acceleration value for the pipe with the lowest median peak floor acceleration value, along with the associated total dispersion (beta). Flooring type assumed to be carpet or vinyl. Available costs are per one square foot of floor area.

Construction Quality:	Normal				
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	By User	Quantity Rounding Round Qty? NO			
Demand Parameter (unit):	Peak Floor Acceleration g	Allow sum by floor or building? NO			
Number of Damage States:	1	Demand Location (floor above?) Yes			
Damage State:	DS1				
Type of Damage State:	Sequential				
DS Hierarchy	Seq(DS1)				
Descriptions	Flooding of all or a portion of the total floor associated with a major leakage of a pipe.				

Illustrations

none				
1.00				

Damage State Probability:					
Fragility Parameters					
Median Demand, δ :	By User				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	Not Specified				
Total Dispersion, β :	By User				
Correlation (Yes / No)	NO	Data Quality	Not Rated	Documentation Quality	Not Rated
Directionality (Yes / No)	NO	Data Relevance	Not Rated	Rationality	Not Rated

Consequence Functions
Repair Description

Replace or dry out of the affected flooring materials, equipment and contents. Remove areas that could be affected by mold. Potentially considerable downtime. Cleanup and replacement of all water damaged items on floor. User must establish area of floor with flooding. Default recommendation is flooding of total floor area. Damage to unit floor area shall be entered to consequence which is multiplied by PACT "Fragility Unit of Measure".

Long Lead Time (Yes / No)

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.62E+01	5.32E+01	7.15E+01												
Best fit mean:	5.37E+01														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	500.00 2000.00														
Average Repair Cost (Min Qty, Max Qty)	1.06E+02 3.19E+01														
CV or beta (Min Qty, Max Qty)	0.26 0.26														
Quantity Unit:	Each (1'x1')														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	3.35E-02	4.93E-02	6.63E-02												
Best fit mean:	4.93E-02														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	500.00 2000.00														
Average Repair Time (Min Qty, Max Qty)	9.86E-02 2.96E-02														
CV or beta (Min Qty, Max Qty)	0.36 0.36														
Quantity Unit:	Each (1'x1')														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	5.6E+01	Normal	0.36												
Embodied Energy (MJ)	6.0E+02	Normal	0.36												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments:	None	Root Cost Multiplier:	1
Date Created:	Not Given	Date Generated:	02/26/19
Approved (YES / NO)?	By User		
Official (YES / NO) ?	By User		
Author:	Not Given		
Revisions:	2015-07-28 Made consequence generic for user specification according to particulars of structure.		

FEMA P-58 Fragility Specification

NISTIR Classification

C3021.001c

Line 385

NISTIR Name
Description

Generic Floor Covering - Flooding of floor caused by failure of pipe - Laboratory - Dry
The user needs to review the fragilities of all piping modeled in the ceiling of the floor and input the peak floor acceleration value for the pipe with the lowest median peak floor acceleration value, along with the associated total dispersion (beta). Flooring type assumed to be sheet vinyl. Available costs are per one square foot of floor area.

Construction Quality:	Normal				
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	By User				
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	1				
Damage State:	DS1				
Type of Damage State:	Sequential				
DS Hierarchy	Seq(DS1)				
Descriptions	Flooding of all or a portion of the total floor associated with a major leakage of a pipe.				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations

none				
1.00				

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	By User				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	Not Specified				
Total Dispersion, β :	By User				
Correlation (Yes / No)	NO	Data Quality	Not Rated	Documentation Quality	Not Rated
Directionality (Yes / No)	NO	Data Relevance	Not Rated	Rationality	Not Rated

Consequence Functions
Repair Description

Replace or dry out of the affected flooring materials, equipment and contents. Remove areas that could be affected by mold. Potentially considerable downtime. Cleanup and replacement of all water damaged items on floor. User must establish area of floor with flooding. Default recommendation is flooding of total floor area. Damage to unit floor area shall be entered to consequence which is multiplied by PACT "Fragility Unit of Measure".

Long Lead Time (Yes / No)

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.34E+01	4.43E+01	5.65E+01												
Best fit mean:	4.14E+01														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	500.00 2000.00														
Average Repair Cost (Min Qty, Max Qty)	8.85E+01 2.66E+01														
CV or beta (Min Qty, Max Qty)	0.31 0.31														
Quantity Unit:	Each (1'x1')														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.17E-02	4.10E-02	5.23E-02												
Best fit mean:	4.10E-02														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	500.00 2000.00														
Average Repair Time (Min Qty, Max Qty)	8.20E-02 2.46E-02														
CV or beta (Min Qty, Max Qty)	0.40 0.40														
Quantity Unit:	Each (1'x1')														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.2E+01	Normal	0.40												
Embodied Energy (MJ)	2.2E+02	Normal	0.40												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments:	None				
Date Created:	Not Given				
Approved (YES / NO)?	By User				
Official (YES / NO) ?	By User				
Author:	Not Given				
Revisions:	2015-07-28 Made consequence generic for user specification according to particulars of structure.				

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

C3021.001d

Generic Floor Covering - Flooding of floor caused by failure of pipe - Laboratory - Humid

The user needs to review the fragilities of all piping modeled in the ceiling of the floor and input the peak floor acceleration value for the pipe with the lowest median peak floor acceleration value, along with the associated total dispersion (beta). Flooring type assumed to be sheet vinyl. Available costs are per one square foot of floor area.

Line 386

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

Not Specified

By User

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

Flooding of all or a portion of the total floor associated with a major leakage of a pipe.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

By User

Not Specified

Not Specified

By User

NO

NO

Data Quality

Not Rated

Documentation Quality

Not Rated

Data Relevance

Not Rated

Rationality

Not Rated

Consequence Functions

Repair Description

Replace or dry out of the affected flooring materials, equipment and contents. Remove areas that could be affected by mold. Potentially considerable downtime. Cleanup and replacement of all water damaged items on floor. User must establish area of floor with flooding. Default recommendation is flooding of total floor area. Damage to unit floor area shall be entered to consequence which is multiplied by PACT "Fragility Unit of Measure".

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

6.86E+01

1.01E+02

1.36E+02

Normal

500.00

2000.00

2.02E+02

6.05E+01

0.26

0.26

Each (1'x1')

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

6.36E-02

9.34E-02

1.26E-01

Normal

500.00

2000.00

1.87E-01

5.60E-02

0.36

0.36

Each (1'x1')

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO₂eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

1.3E+02

Normal

0.36

1.3E+03

Normal

0.36

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2015-07-28 Made consequence generic for user specification according to particulars of structure.

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

C3021.001e

Line 387

NISTIR Name
Description

Generic Floor Covering - Flooding of floor caused by failure of pipe - Hospital - Dry
The user needs to review the fragilities of all piping modeled in the ceiling of the floor and input the peak floor acceleration value for the pipe with the lowest median peak floor acceleration value, along with the associated total dispersion (beta). Flooring type assumed to be sheet vinyl. Available costs are per one square foot of floor area.

Construction Quality:	Normal				
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	By User				
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	1				
Damage State:	DS1				
Type of Damage State:	Sequential				
DS Hierarchy	Seq(DS1)				
Descriptions	Flooding of all or a portion of the total floor associated with a major leakage of a pipe.				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	Yes	

Illustrations

none				
1.00				

Damage State Probability:					
Fragility Parameters					
Median Demand, δ :	By User				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	Not Specified				
Total Dispersion, β :	By User				
Correlation (Yes / No)	NO	Data Quality	Not Rated	Documentation Quality	Not Rated
Directionality (Yes / No)	NO	Data Relevance	Not Rated	Rationality	Not Rated

Consequence Functions
Repair Description

Replace or dry out of the affected flooring materials, equipment and contents. Remove areas that could be affected by mold. Potentially considerable downtime. Cleanup and replacement of all water damaged items on floor. User must establish area of floor with flooding. Default recommendation is flooding of total floor area. Damage to unit floor area shall be entered to consequence which is multiplied by PACT "Fragility Unit of Measure".

Long Lead Time (Yes / No)

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.45E+01	3.86E+01	4.95E+01												
Best fit mean:	3.75E+01														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	500.00 2000.00														
Average Repair Cost (Min Qty, Max Qty)	7.72E+01 2.32E+01														
CV or beta (Min Qty, Max Qty)	0.26 0.26														
Quantity Unit:	Each (1'x1')														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.27E-02	3.58E-02	4.59E-02												
Best fit mean:	3.58E-02														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	500.00 2000.00														
Average Repair Time (Min Qty, Max Qty)	7.16E-02 2.15E-02														
CV or beta (Min Qty, Max Qty)	0.36 0.36														
Quantity Unit:	Each (1'x1')														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.5E+01	Normal	0.36												
Embodied Energy (MJ)	2.5E+02	Normal	0.36												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0% 0.00														
Loss of Life (Median, Dispersion)	0% 0.00														
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00														

Comments:	None				
Date Created:	Not Given				
Approved (YES / NO)?	By User				
Official (YES / NO) ?	By User				
Author:	Not Given				
Revisions:	2015-07-28 Made consequence generic for user specification according to particulars of structure.				
		Root Cost Multiplier:	1		
		Date Generated:	02/26/19		

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

C3021.001f

Generic Floor Covering - Flooding of floor caused by failure of pipe - Hospital - Humid

The user needs to review the fragilities of all piping modeled in the ceiling of the floor and input the peak floor acceleration value for the pipe with the lowest median peak floor acceleration value, along with the associated total dispersion (beta). Flooring type assumed to be sheet vinyl. Available costs are per one square foot of floor area.

Line 388

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

Not Specified

By User

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

Flooding of all or a portion of the total floor associated with a major leakage of a pipe.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

By User

Not Specified

Not Specified

By User

NO

NO

Data Quality

Not Rated

Data Relevance

Not Rated

Documentation Quality

Not Rated

Rationality

Not Rated

Consequence Functions

Repair Description

Replace or dry out of the affected flooring materials, equipment and contents. Remove areas that could be affected by mold. Potentially considerable downtime. Cleanup and replacement of all water damaged items on floor. User must establish area of floor with flooding. Default recommendation is flooding of total floor area. Damage to unit floor area shall be entered to consequence which is multiplied by PACT "Fragility Unit of Measure".

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

8.30E+01

1.12E+02

1.52E+02

LogNormal

500.00

2000.00

2.24E+02

6.71E+01

0.24

0.24

Each (1'x1')

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

7.69E-02

1.04E-01

1.41E-01

LogNormal

500.00

2000.00

2.07E-01

6.22E-02

0.34

0.34

Each (1'x1')

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO₂eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

1.7E+02

LogNormal

0.34

1.7E+03

LogNormal

0.34

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2015-07-28 Made consequence generic for user specification according to particulars of structure.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

C3021.001g

Line 389

NISTIR Name
Description

Generic Floor Covering - Flooding of floor caused by failure of pipe - School - Dry
The user needs to review the fragilities of all piping modeled in the ceiling of the floor and input the peak floor acceleration value for the pipe with the lowest median peak floor acceleration value, along with the associated total dispersion (beta). Flooring type assumed to be vinyl composition tile. Available costs are per one square foot of floor area.

Construction Quality:	Normal				
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	By User				
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	1				
Damage State:	DS1				
Type of Damage State:	Sequential				
DS Hierarchy	Seq(DS1)				
Descriptions	Flooding of all or a portion of the total floor associated with a major leakage of a pipe.				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	Yes	

Illustrations

none				
1.00				

Damage State Probability:					
Fragility Parameters					
Median Demand, δ :	By User				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	Not Specified				
Total Dispersion, β :	By User				
Correlation (Yes / No)	NO	Data Quality	Not Rated	Documentation Quality	Not Rated
Directionality (Yes / No)	NO	Data Relevance	Not Rated	Rationality	Not Rated

Consequence Functions
Repair Description

Replace or dry out of the affected flooring materials, equipment and contents. Remove areas that could be affected by mold. Potentially considerable downtime. Cleanup and replacement of all water damaged items on floor. User must establish area of floor with flooding. Default recommendation is flooding of total floor area. Damage to unit floor area shall be entered to consequence which is multiplied by PACT "Fragility Unit of Measure".

Long Lead Time (Yes / No)

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.23E+01	1.74E+01	2.25E+01												
Best fit mean:	1.74E+01														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	500.00			2000.00											
Average Repair Cost (Min Qty, Max Qty)	3.47E+01			1.04E+01											
CV or beta (Min Qty, Max Qty)	0.23			0.23											
Quantity Unit:	Each (1'x1')														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.14E-02	1.61E-02	2.09E-02												
Best fit mean:	1.61E-02														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	500.00			2000.00											
Average Repair Time (Min Qty, Max Qty)	3.22E-02			9.67E-03											
CV or beta (Min Qty, Max Qty)	0.34			0.34											
Quantity Unit:	Each (1'x1')														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	5.7E+00	Normal	0.34												
Embodied Energy (MJ)	1.0E+02	Normal	0.34												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%			0.00											
Loss of Life (Median, Dispersion)	0%			0.00											
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%			0.00											

Comments:	None	Root Cost Multiplier:	1
Date Created:	Not Given	Date Generated:	02/26/19
Approved (YES / NO)?	By User		
Official (YES / NO) ?	By User		
Author:	Not Given		
Revisions:	2015-07-28 Made consequence generic for user specification according to particulars of structure.		

FEMA P-58 Fragility Specification

NISTIR Classification

C3021.001h

Line 390

NISTIR Name
Description

Generic Floor Covering - Flooding of floor caused by failure of pipe - School - Humid
The user needs to review the fragilities of all piping modeled in the ceiling of the floor and input the peak floor acceleration value for the pipe with the lowest median peak floor acceleration value, along with the associated total dispersion (beta). Flooring type assumed to be vinyl composition tile. Available costs are per one square foot of floor area.

Construction Quality:	Normal				
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	By User	Quantity Rounding Round Qty? NO			
Demand Parameter (unit):	Peak Floor Acceleration g	Allow sum by floor or building? NO			
Number of Damage States:	1	Demand Location (floor above?) Yes			
Damage State:	DS1				
Type of Damage State:	Sequential				
DS Hierarchy	Seq(DS1)				
Descriptions	Flooding of all or a portion of the total floor associated with a major leakage of a pipe.				

Illustrations

none				
1.00				

Damage State Probability:					
Fragility Parameters					
Median Demand, δ :	By User				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	Not Specified				
Total Dispersion, β :	By User				
Correlation (Yes / No)	NO	Data Quality	Not Rated	Documentation Quality	Not Rated
Directionality (Yes / No)	NO	Data Relevance	Not Rated	Rationality	Not Rated

Consequence Functions
Repair Description

Replace or dry out of the affected flooring materials, equipment and contents. Remove areas that could be affected by mold. Potentially considerable downtime. Cleanup and replacement of all water damaged items on floor. User must establish area of floor with flooding. Default recommendation is flooding of total floor area. Damage to unit floor area shall be entered to consequence which is multiplied by PACT "Fragility Unit of Measure".

Long Lead Time (Yes / No)

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.06E+01	4.62E+01	6.21E+01												
Best fit mean:	4.63E+01														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	500.00		2000.00												
Average Repair Cost (Min Qty, Max Qty)	9.24E+01		2.77E+01												
CV or beta (Min Qty, Max Qty)	0.27		0.27												
Quantity Unit:	Each (1'x1')														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.83E-02	4.28E-02	5.75E-02												
Best fit mean:	4.28E-02														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	500.00		2000.00												
Average Repair Time (Min Qty, Max Qty)	8.56E-02		2.57E-02												
CV or beta (Min Qty, Max Qty)	0.36		0.36												
Quantity Unit:	Each (1'x1')														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	5.7E+01	Normal	0.36												
Embodied Energy (MJ)	5.9E+02	Normal	0.36												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments:	None	Root Cost Multiplier:	1
Date Created:	Not Given	Date Generated:	02/26/19
Approved (YES / NO)?	By User		
Official (YES / NO) ?	By User		
Author:	Not Given		
Revisions:	2015-07-28 Made consequence generic for user specification according to particulars of structure.		

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

C3021.001i

Generic Floor Covering - Flooding of floor caused by failure of pipe - Apartments - Dry

The user needs to review the fragilities of all piping modeled in the ceiling of the floor and input the peak floor acceleration value for the pipe with the lowest median peak floor acceleration value, along with the associated total dispersion (beta). Flooring type assumed to be carpet. Available costs are per one square foot of floor area.

Line 391

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

Not Specified

By User

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

Flooding of all or a portion of the total floor associated with a major leakage of a pipe.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

By User

Not Specified

Not Specified

By User

Correlation (Yes / No)

Directionality (Yes / No)

NO

NO

Data Quality

Not Rated

Data Relevance

Not Rated

Documentation Quality

Not Rated

Rationality

Not Rated

Consequence Functions

Repair Description

Replace or dry out of the affected flooring materials, equipment and contents. Remove areas that could be affected by mold. Potentially considerable downtime. Cleanup and replacement of all water damaged items on floor. User must establish area of floor with flooding. Default recommendation is flooding of total floor area. Damage to unit floor area shall be entered to consequence which is multiplied by PACT "Fragility Unit of Measure".

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.64E+01

2.65E+01

3.46E+01

2.58E+01

Normal

500.00

2000.00

5.30E+01

1.59E+01

0.27

0.27

Each (1'x1')

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.52E-02

2.46E-02

3.21E-02

2.46E-02

Normal

500.00

2000.00

4.92E-02

1.48E-02

0.37

0.37

Each (1'x1')

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

1.2E+01

Normal

0.37

1.7E+02

Normal

0.37

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2015-07-28 Made consequence generic for user specification according to particulars of structure.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

C3021.001j

Generic Floor Covering - Flooding of floor caused by failure of pipe - Apartments - Humid

The user needs to review the fragilities of all piping modeled in the ceiling of the floor and input the peak floor acceleration value for the pipe with the lowest median peak floor acceleration value, along with the associated total dispersion (beta). Flooring type assumed to be carpet. Available costs are per one square foot of floor area.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

Not Specified

By User

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

Flooding of all or a portion of the total floor associated with a major leakage of a pipe.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

NO

NO

Data Quality

Not Rated

Data Relevance

Not Rated

Documentation Quality

Not Rated

Rationality

Not Rated

Consequence Functions

Repair Description

Replace or dry out of the affected flooring materials, equipment and contents. Remove areas that could be affected by mold. Potentially considerable downtime. Cleanup and replacement of all water damaged items on floor. User must establish area of floor with flooding. Default recommendation is flooding of total floor area. Damage to unit floor area shall be entered to consequence which is multiplied by PACT "Fragility Unit of Measure".

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Each (1'x1')

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Each (1'x1')

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2015-07-28 Made consequence generic for user specification according to particulars of structure.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

C3021.001k

Line 393

NISTIR Name

Generic Floor Covering - Flooding of floor caused by failure of pipe - Retail - Dry

Description

The user needs to review the fragilities of all piping modeled in the ceiling of the floor and input the peak floor acceleration value for the pipe with the lowest median peak floor acceleration value, along with the associated total dispersion (beta). Flooring type assumed to be vinyl composition tile. Available costs are per one square foot of floor area.

Construction Quality:

Normal

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

By User

Demand Parameter (unit):

Peak Floor Acceleration g

Number of Damage States:

1

Damage State:

DS1

Type of Damage State:

Sequential

DS Hierarchy

Seq(DS1)

Descriptions

Flooding of all or a portion of the total floor associated with a major leakage of a pipe.

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	Yes	

Illustrations

none				
1.00				

Damage State Probability:

Fragility Parameters

Median Demand, δ :

By User

Data dispersion, β_d :

Not Specified

Uncertainty, β_u :

Not Specified

Total Dispersion, β :

By User

Correlation (Yes / No)

NO

Directionality (Yes / No)

NO

Data Quality Not Rated

Data Relevance Not Rated

Documentation Quality Not Rated

Rationality Not Rated

Consequence Functions

Repair Description

Replace or dry out of the affected flooring materials, equipment and contents. Remove areas that could be affected by mold. Potentially considerable downtime. Cleanup and replacement of all water damaged items on floor. User must establish area of floor with flooding. Default recommendation is flooding of total floor area. Damage to unit floor area shall be entered to consequence which is multiplied by PACT "Fragility Unit of Measure".

Long Lead Time (Yes / No)

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.39E+01	2.94E+01	3.79E+01												
Best fit mean:	2.71E+01														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	500.00 2000.00														
Average Repair Cost (Min Qty, Max Qty)	5.88E+01 1.76E+01														
CV or beta (Min Qty, Max Qty)	0.35 0.35														
Quantity Unit:	Each (1'x1')														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.29E-02	2.72E-02	3.51E-02												
Best fit mean:	2.72E-02														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	500.00 2000.00														
Average Repair Time (Min Qty, Max Qty)	5.44E-02 1.63E-02														
CV or beta (Min Qty, Max Qty)	0.43 0.43														
Quantity Unit:	Each (1'x1')														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	5.1E+00	Normal	0.43												
Embodied Energy (MJ)	1.0E+02	Normal	0.43												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0% 0.00														
Loss of Life (Median, Dispersion)	0% 0.00														
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00														

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2015-07-28 Made consequence generic for user specification according to particulars of structure.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

C3021.0011

Line 394

NISTIR Name
Description

Generic Floor Covering - Flooding of floor caused by failure of pipe - Retail - Humid
The user needs to review the fragilities of all piping modeled in the ceiling of the floor and input the peak floor acceleration value for the pipe with the lowest median peak floor acceleration value, along with the associated total dispersion (beta). Flooring type assumed to be vinyl composition tile. Available costs are per one square foot of floor area.

Construction Quality:
Seismic Installation Conditions:
Fragility Unit of Measure:
Demand Parameter (unit):
Number of Damage States:
Damage State:
Type of Damage State:
DS Hierarchy
Descriptions

Normal
Not Specified
By User
Peak Floor Acceleration g
1
DS1
Sequential
Seq(DS1)
Flooding of all or a portion of the total floor associated with a major leakage of a pipe.

Quantity Rounding
Round Qty?
Allow sum by floor or building?
Demand Location (floor above?)

NO
NO
NO
Yes

Illustrations

none				
1.00				

Damage State Probability:
Fragility Parameters
Median Demand, θ :
Data dispersion, β_d :
Uncertainty, β_u :
Total Dispersion, β :
Correlation (Yes / No)
Directionality (Yes / No)

By User
Not Specified
Not Specified
By User
NO
NO

Data Quality
Data Relevance

Not Rated
Not Rated

Documentation Quality
Rationality

Not Rated
Not Rated

Consequence Functions
Repair Description

Replace or dry out of the affected flooring materials, equipment and contents. Remove areas that could be affected by mold. Potentially considerable downtime. Cleanup and replacement of all water damaged items on floor. User must establish area of floor with flooding. Default recommendation is flooding of total floor area. Damage to unit floor area shall be entered to consequence which is multiplied by PACT "Fragility Unit of Measure".

Long Lead Time (Yes / No)

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.99E+01	4.94E+01	6.60E+01												
Best fit mean:	4.84E+01														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	500.00 2000.00														
Average Repair Cost (Min Qty, Max Qty)	9.88E+01 2.96E+01														
CV or beta (Min Qty, Max Qty)	0.29 0.29														
Quantity Unit:	Each (1'x1')														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.77E-02	4.58E-02	6.11E-02												
Best fit mean:	4.58E-02														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	500.00 2000.00														
Average Repair Time (Min Qty, Max Qty)	9.16E-02 2.75E-02														
CV or beta (Min Qty, Max Qty)	0.38 0.38														
Quantity Unit:	Each (1'x1')														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	5.1E+01	Normal	0.38												
Embodied Energy (MJ)	5.4E+02	Normal	0.38												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0% 0.00														
Loss of Life (Median, Dispersion)	0% 0.00														
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00														

Comments:
Date Created:
Approved (YES / NO)?
Official (YES / NO) ?
Author:
Revisions:

None
Not Given
By User
By User
Not Given
2015-07-28 Made consequence generic for user specification according to particulars of structure.

Root Cost Multiplier:
Date Generated:

1
02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

C3021.001m

Generic Floor Covering - Flooding of floor caused by failure of pipe - Warehouse - Dry

The user needs to review the fragilities of all piping modeled in the ceiling of the floor and input the peak floor acceleration value for the pipe with the lowest median peak floor acceleration value, along with the associated total dispersion (beta). Flooring type assumed to be sealed concrete. Available costs are per one square foot of floor area.

Line 395

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

Not Specified

By User

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

Flooding of all or a portion of the total floor associated with a major leakage of a pipe.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

By User

Not Specified

Not Specified

By User

NO

NO

Data Quality

Not Rated

Documentation Quality

Not Rated

Data Relevance

Not Rated

Rationality

Not Rated

Consequence Functions

Repair Description

Replace or dry out of the affected flooring materials, equipment and contents. Remove areas that could be affected by mold. Potentially considerable downtime. Cleanup and replacement of all water damaged items on floor. User must establish area of floor with flooding. Default recommendation is flooding of total floor area. Damage to unit floor area shall be entered to consequence which is multiplied by PACT "Fragility Unit of Measure".

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

4.04E+00

1.01E+01

1.35E+01

9.19E+00

Normal

500.00

2000.00

2.01E+01

6.03E+00

0.40

0.40

Each (1'x1')

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

3.70E-03

9.30E-03

1.25E-02

9.30E-03

Normal

500.00

2000.00

1.86E-02

5.58E-03

0.47

0.47

Each (1'x1')

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

9.5E-01

Normal

0.47

1.3E+01

Normal

0.47

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2015-07-28 Made consequence generic for user specification according to particulars of structure.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

C3021.001n

Line 396

NISTIR Name

Generic Floor Covering - Flooding of floor caused by failure of pipe - Warehouse - Humid

Description

The user needs to review the fragilities of all piping modeled in the ceiling of the floor and input the peak floor acceleration value for the pipe with the lowest median peak floor acceleration value, along with the associated total dispersion (beta). Flooring type assumed to be sealed concrete. Available costs are per one square foot of floor area.

Construction Quality:

Normal

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

By User

Demand Parameter (unit):

Peak Floor Acceleration g

Number of Damage States:

1

Damage State:

DS1

Type of Damage State:

Sequential

DS Hierarchy

Seq(DS1)

Descriptions

Flooding of all or a portion of the total floor associated with a major leakage of a pipe.

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations

none				
1.00				

Damage State Probability:

Fragility Parameters

Median Demand, δ :

By User

Data dispersion, β_d :

Not Specified

Uncertainty, β_u :

Not Specified

Total Dispersion, β :

By User

Correlation (Yes / No)

NO

Directionality (Yes / No)

NO

Data Quality Not Rated

Data Relevance Not Rated

Documentation Quality Not Rated

Rationality Not Rated

Consequence Functions

Repair Description

Replace or dry out of the affected flooring materials, equipment and contents. Remove areas that could be affected by mold. Potentially considerable downtime. Cleanup and replacement of all water damaged items on floor. User must establish area of floor with flooding. Default recommendation is flooding of total floor area. Damage to unit floor area shall be entered to consequence which is multiplied by PACT "Fragility Unit of Measure".

Long Lead Time (Yes / No)

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.28E+01	2.40E+01	3.26E+01												
Best fit mean:	2.31E+01														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	500.00 2000.00														
Average Repair Cost (Min Qty, Max Qty)	4.80E+01 1.44E+01														
CV or beta (Min Qty, Max Qty)	0.33 0.33														
Quantity Unit:	Each (1'x1')														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.19E-02	2.22E-02	3.02E-02												
Best fit mean:	2.22E-02														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	500.00 2000.00														
Average Repair Time (Min Qty, Max Qty)	4.44E-02 1.33E-02														
CV or beta (Min Qty, Max Qty)	0.42 0.42														
Quantity Unit:	Each (1'x1')														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	2.7E+01	Normal	0.42												
Embodied Energy (MJ)	2.6E+02	Normal	0.42												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0% 0.00														
Loss of Life (Median, Dispersion)	0% 0.00														
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00														

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2015-07-28 Made consequence generic for user specification according to particulars of structure.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

C3021.001o

Generic Floor Covering - Flooding of floor caused by failure of pipe - Hospitality - Dry

The user needs to review the fragilities of all piping modeled in the ceiling of the floor and input the peak floor acceleration value for the pipe with the lowest median peak floor acceleration value, along with the associated total dispersion (beta). Flooring type assumed to be carpet. Available costs are per one square foot of floor area.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

Not Specified

By User

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

Flooding of all or a portion of the total floor associated with a major leakage of a pipe.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

none

1.00

Damage State Probability:

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

By User

Not Specified

Not Specified

By User

Correlation (Yes / No)

NO

Data Quality

Not Rated

Documentation Quality

Not Rated

Directionality (Yes / No)

NO

Data Relevance

Not Rated

Rationality

Not Rated

Consequence Functions

Repair Description

Replace or dry out of the affected flooring materials, equipment and contents. Remove areas that could be affected by mold. Potentially considerable downtime. Cleanup and replacement of all water damaged items on floor. User must establish area of floor with flooding. Default recommendation is flooding of total floor area. Damage to unit floor area shall be entered to consequence which is multiplied by PACT "Fragility Unit of Measure".

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.43E+01

2.79E+01

3.57E+01

2.60E+01

Normal

500.00

2000.00

5.58E+01

1.67E+01

0.32

0.32

Each (1'x1')

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.39E-02

2.71E-02

3.47E-02

2.71E-02

Normal

500.00

2000.00

5.42E-02

1.63E-02

0.41

0.41

Each (1'x1')

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

1.5E+01

Normal

0.41

2.0E+02

Normal

0.41

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2015-07-28 Made consequence generic for user specification according to particulars of structure.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

C3021.001p

Line 398

NISTIR Name
Description

Generic Floor Covering - Flooding of floor caused by failure of pipe - Hospitality - Humid
The user needs to review the fragilities of all piping modeled in the ceiling of the floor and input the peak floor acceleration value for the pipe with the lowest median peak floor acceleration value, along with the associated total dispersion (beta). Flooring type assumed to be carpet. Available costs are per one square foot of floor area.

Construction Quality:	Normal				
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	By User				
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	1				
Damage State:	DS1				
Type of Damage State:	Sequential				
DS Hierarchy	Seq(DS1)				
Descriptions	Flooding of all or a portion of the total floor associated with a major leakage of a pipe.				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations

none				
1.00				

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	By User				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	Not Specified				
Total Dispersion, β :	By User				
Correlation (Yes / No)	NO	Data Quality	Not Rated	Documentation Quality	Not Rated
Directionality (Yes / No)	NO	Data Relevance	Not Rated	Rationality	Not Rated

Consequence Functions
Repair Description

Replace or dry out of the affected flooring materials, equipment and contents. Remove areas that could be affected by mold. Potentially considerable downtime. Cleanup and replacement of all water damaged items on floor. User must establish area of floor with flooding. Default recommendation is flooding of total floor area. Damage to unit floor area shall be entered to consequence which is multiplied by PACT "Fragility Unit of Measure".

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	4.82E+01	7.02E+01	9.52E+01												
Best fit mean:	7.12E+01														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	500.00		2000.00												
Average Repair Cost (Min Qty, Max Qty)	8.42E+01		5.62E+01												
CV or beta (Min Qty, Max Qty)	0.26		0.26												
Quantity Unit:	Each (1'x1')														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	4.67E-02	6.81E-02	9.24E-02												
Best fit mean:	6.81E-02														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	500.00		2000.00												
Average Repair Time (Min Qty, Max Qty)	8.17E-02		5.45E-02												
CV or beta (Min Qty, Max Qty)	0.36		0.36												
Quantity Unit:	Each (1'x1')														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.2E+02	Normal	0.36												
Embodied Energy (MJ)	1.2E+03	Normal	0.36												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments:	None				
Date Created:	Not Given				
Approved (YES / NO)?	By User				
Official (YES / NO) ?	By User				
Author:	Not Given				
Revisions:	2015-07-28 Made consequence generic for user specification according to particulars of structure.				
		Root Cost Multiplier:	1		
		Date Generated:	02/26/19		

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

C3027.001

Raised Access Floor, non seismically rated.

Access floor unanchored or anchored with adhesive. Costing is based upon a xxx SF floor area.

Line 399

Construction Quality:	Normal				
Seismic Installation Conditions:	All				
Fragility Unit of Measure:	SF 100				
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	1				
Damage State:	DS1				
Type of Damage State:	Sequential				
DS Hierarchy	Seq(DS1)				
Descriptions	Minor damage to the flooring system. Damage to the equipment of the flooring system.				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

none				
1.00				

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.5				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	Not Specified				
Total Dispersion, β :	0.5				
Correlation (Yes / No)	NO	Data Quality	Not Rated	Documentation Quality	Not Rated
Directionality (Yes / No)	NO	Data Relevance	Not Rated	Rationality	Not Rated

Consequence Functions

Repair Description

Repair the flooring system, assume cost equal to 5% of the replacement cost. Repair the flooring equipment, assume a cost equal to 10% of the replacement cost.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	4.00E+01	1.15E+02	6.30E+02												
Best fit mean:	1.21E+02														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00												
Average Repair Cost (Min Qty, Max Qty)	1.38E+02		9.20E+01												
CV or beta (Min Qty, Max Qty)	1.28		1.28												
Quantity Unit:	100 ft^2 Units														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	4.00E-02	1.10E-01	6.10E-01												
Best fit mean:	1.10E-01														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00												
Average Repair Time (Min Qty, Max Qty)	1.32E-01		8.77E-02												
CV or beta (Min Qty, Max Qty)	1.31		1.31												
Quantity Unit:	100 ft^2 Units														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.0E+00	LogNormal	1.31												
Embodied Energy (MJ)	1.6E+02	LogNormal	1.31												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

Consequence Note: Some downtime for repair of floor and equipment.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

100

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

C3027.002

Line 400

NISTIR Name
Description

Raised Access Floor, seismically rated.
Access floor is designed to meet code requirements and mechanically anchored and braced as necessary to resist anchor loads. Equipment is anchored to floor systems and heavier equipment is anchored directly to the structural floor. Costing is based upon a xxx SF floor area.

Construction Quality:	Normal				
Seismic Installation Conditions:	All				
Fragility Unit of Measure:	SF 100				
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	1				
Damage State:	DS1				
Type of Damage State:	Sequential				
DS Hierarchy	Seq(DS1)				
Descriptions	Minor damage to the flooring system. Damage to the equipment of the flooring system.				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	NO	NO

Illustrations

none				
1.00				

Damage State Probability:	1.00				
Fragility Parameters					
Median Demand, θ :	1.5				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	Not Specified				
Total Dispersion, β :	0.4				
Correlation (Yes / No)	NO		Data Quality	Not Rated	Documentation Quality
Directionality (Yes / No)	NO		Data Relevance	Not Rated	Rationality

Consequence Functions
Repair Description

Repair the flooring system, assume cost equal to 5% of the replacement cost. Repair the flooring equipment, assume a cost equal to 10% of the replacement cost.

Long Lead Time (Yes / No)

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	4.00E+01	1.15E+02	6.30E+02												
Best fit mean:	1.21E+02														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00														
Average Repair Cost (Min Qty, Max Qty)	1.38E+02 9.20E+01														
CV or beta (Min Qty, Max Qty)	1.28 1.28														
Quantity Unit:	100 ft^2 Units														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	4.00E-02	1.20E-01	6.80E-01												
Best fit mean:	1.20E-01														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00														
Average Repair Time (Min Qty, Max Qty)	1.45E-01 9.53E-02														
CV or beta (Min Qty, Max Qty)	1.31 1.31														
Quantity Unit:	100 ft^2 Units														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.0E+00	LogNormal	1.31												
Embodied Energy (MJ)	1.6E+02	LogNormal	1.31												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0% 0.00														
Loss of Life (Median, Dispersion)	0% 0.00														
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00														

Comments:

Consequence Note: Some downtime for repair of floor and equipment.
Not Given
By User
By User
Not Given
None

Date Created:
Approved (YES / NO)?
Official (YES / NO) ?
Author:
Revisions:

Root Cost Multiplier: 100
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

C3032.001a

Line 401

NISTIR Name
Description

Suspended Ceiling, SDC A,B,C, Area (A): A < 250, Vert support only
Costing for each 250 SF Unit, Suspended Lay-in Acoustic Tile Ceiling, Support: Vertical hanging wires only. Includes lighting fixtures in suspended ceiling.

Construction Quality:	Normal			
Seismic Installation Conditions:	SDC A, B, or C			
Fragility Unit of Measure:	SF 250			
Demand Parameter (unit):	Peak Floor Acceleration g			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1.DS2.DS3)			
Descriptions	5 % of ceiling grid and tile damage.	30% of ceiling grid and tile damage.	50% of ceiling grid and tile damage.	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	Yes	

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	1.17	1.58	1.82	
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified	
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified	
Total Dispersion, β :	0.25	0.25	0.25	
Correlation (Yes / No)	NO	Data Quality Marginal	Documentation Quality Marginal	
Directionality (Yes / No)	NO	Data Relevance Superior	Rationality Average	

Consequence Functions

Repair Description	Reinstall, repair, or replace 5% of the ceiling area.	Replace 30% of the ceiling area.	Replace the entire ceiling
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Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.00E+02	3.63E+02	6.00E+02	1.35E+03	2.84E+03	5.35E+03	4.69E+03	5.84E+03	7.79E+03						
Best fit mean:	3.54E+02			2.76E+03			5.97E+03								
Best Fit Distribution:	Normal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00 10.00			1.00 10.00			1.00 10.00								
Average Repair Cost (Min Qty, Max Qty)	4.35E+02 2.90E+02			3.41E+03 2.27E+03			7.01E+03 4.67E+03								
CV or beta (Min Qty, Max Qty)	0.55 0.55			0.52 0.52			0.20 0.20								
Quantity Unit:	250 ft^2 Units			250 ft^2 Units			250 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.00E-01	3.50E-01	5.75E-01	1.30E+00	2.70E+00	5.13E+00	4.48E+00	5.58E+00	7.45E+00						
Best fit mean:	3.50E-01			2.70E+00			5.58E+00								
Best Fit Distribution:	Normal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00 10.00			1.00 10.00			1.00 10.00								
Average Repair Time (Min Qty, Max Qty)	4.19E-01 2.81E-01			3.24E+00 2.16E+00			6.69E+00 4.46E+00								
CV or beta (Min Qty, Max Qty)	0.60 0.60			0.58 0.58			0.32 0.32								
Quantity Unit:	250 ft^2 Units			250 ft^2 Units			250 ft^2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.2E+02	Normal	0.60	2.1E+03	LogNormal	0.58	8.2E+03	LogNormal	0.32						
Embodied Energy (MJ)	2.2E+03	Normal	0.60	2.9E+04	LogNormal	0.58	8.1E+04	LogNormal	0.32						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			YES								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			250 SF								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		10%	0.50							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			NO								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2015-07-28 Update median demand and dispersion beta. 2015-08-21 Added SDC C

Root Cost Multiplier: 250
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

C3032.001b

Line 402

NISTIR Name
Description

Suspended Ceiling, SDC A,B,C, Area (A): 250 < A < 1000, Vert support only
Costing for each 600 SF Unit, Suspended Lay-in Acoustic Tile Ceiling, Support: Vertical hanging wires only. Includes lighting fixtures in suspended ceiling.

Construction Quality:	Normal			
Seismic Installation Conditions:	SDC A, B, or C			
Fragility Unit of Measure:	SF 600			
Demand Parameter (unit):	Peak Floor Acceleration g			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	5 % of ceiling grid and tile damage.	30% of ceiling grid and tile damage.	50% of ceiling grid and tile damage.	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	1.01	1.45	1.69	
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified	
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified	
Total Dispersion, β :	0.25	0.25	0.25	
Correlation (Yes / No)	NO	Data Quality Marginal	Documentation Quality Marginal	
Directionality (Yes / No)	NO	Data Relevance Superior	Rationality Average	

Consequence Functions

Repair Description

Reinstall, repair, or replace 5% of the ceiling area. Replace 30% of the ceiling area. Replace the entire ceiling area.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.40E+02	8.70E+02	1.44E+03	3.24E+03	6.81E+03	1.28E+04	1.13E+04	1.40E+04	1.87E+04						
Best fit mean:	8.50E+02 Normal			6.63E+03 LogNormal			1.43E+04 LogNormal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	1.00 10.00			1.00 10.00			1.00 10.00								
Average Repair Cost (Min Qty, Max Qty)	1.04E+03 6.96E+02			8.17E+03 5.45E+03			1.68E+04 1.12E+04								
CV or beta (Min Qty, Max Qty)	0.55 0.55			0.52 0.52			0.20 0.20								
Quantity Unit:	600 ft^2 Units			600 ft^2 Units			600 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.40E-01	7.80E-01	1.32E+00	2.94E+00	6.18E+00	1.17E+01	1.03E+01	1.28E+01	1.70E+01						
Best fit mean:	7.80E-01 Normal			6.18E+00 LogNormal			1.28E+01 LogNormal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	1.00 10.00			1.00 10.00			1.00 10.00								
Average Repair Time (Min Qty, Max Qty)	9.39E-01 6.21E-01			7.42E+00 4.94E+00			1.53E+01 1.02E+01								
CV or beta (Min Qty, Max Qty)	0.60 0.60			0.58 0.58			0.32 0.32								
Quantity Unit:	600 ft^2 Units			600 ft^2 Units			600 ft^2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	5.2E+02	Normal	0.60	5.1E+03	LogNormal	0.58	2.0E+04	LogNormal	0.32						
Embodied Energy (MJ)	5.2E+03	Normal	0.60	6.9E+04	LogNormal	0.58	1.9E+05	LogNormal	0.32						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			YES								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			650 SF								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		10%	0.50							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			NO								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							

Comments:

None
Not Given
By User
By User
Not Given
2015-07-28 Update median demand and dispersion beta. 2015-08-21 Added SDC C

Root Cost Multiplier: 600
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

C3032.001c

NISTIR Name
Description

Suspended Ceiling, SDC A,B,C, Area (A): 1000 < A < 2500, Vert support only
Costing for each 1800 SF Unit, Suspended Lay-in Acoustic Tile Ceiling, Support: Vertical hanging wires only. Includes lighting fixtures in suspended ceiling.

Line 403

Construction Quality:	Normal			
Seismic Installation Conditions:	SDC A, B, or C			
Fragility Unit of Measure:	SF 1800			
Demand Parameter (unit):	Peak Floor Acceleration g			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1.DS2.DS3)			
Descriptions	5 % of ceiling grid and tile damage.	30% of ceiling grid and tile damage.	50% of ceiling grid and tile damage.	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	Yes	

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	0.7	1.2	1.43	
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified	
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified	
Total Dispersion, β :	0.25	0.25	0.25	
Correlation (Yes / No)	NO	Data Quality Marginal	Documentation Quality Marginal	
Directionality (Yes / No)	NO	Data Relevance Superior	Rationality Average	

Consequence Functions

Repair Description	Reinstall, repair, or replace 5% of the ceiling area.	Replace 30% of the ceiling area.	Replace the entire ceiling	
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Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	7.20E+02	2.61E+03	4.32E+03	9.72E+03	2.04E+04	3.85E+04	3.38E+04	4.20E+04	5.61E+04						
Best fit mean:	2.55E+03			1.99E+04			4.30E+04								
Best Fit Distribution:	Normal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00 10.00			1.00 10.00			1.00 10.00								
Average Repair Cost (Min Qty, Max Qty)	3.13E+03 2.09E+03			2.45E+04 1.63E+04			5.04E+04 3.36E+04								
CV or beta (Min Qty, Max Qty)	0.55 0.55			0.52 0.52			0.20 0.20								
Quantity Unit:	1800 ft^2 Units			1800 ft^2 Units			1800 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	7.20E-01	2.34E+00	3.78E+00	8.64E+00	1.80E+01	3.40E+01	2.97E+01	3.71E+01	4.95E+01						
Best fit mean:	2.34E+00			1.80E+01			3.71E+01								
Best Fit Distribution:	Normal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00 10.00			1.00 10.00			1.00 10.00								
Average Repair Time (Min Qty, Max Qty)	2.80E+00 1.88E+00			2.16E+01 1.44E+01			4.45E+01 2.97E+01								
CV or beta (Min Qty, Max Qty)	0.60 0.60			0.58 0.58			0.32 0.32								
Quantity Unit:	1800 ft^2 Units			1800 ft^2 Units			1800 ft^2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.6E+03	Normal	0.60	1.5E+04	LogNormal	0.58	5.9E+04	LogNormal	0.32						
Embodied Energy (MJ)	1.6E+04	Normal	0.60	2.1E+05	LogNormal	0.58	5.8E+05	LogNormal	0.32						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			YES								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			1700 SF								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		10%	0.50							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			NO								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							

Comments:

None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2015-07-28 Update median demand and dispersion beta. 2015-08-21 Added SDC C

Root Cost Multiplier: 1800
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

C3032.001d

NISTIR Name
Description

Suspended Ceiling, SDC A,B,C, Area (A): A > 2500, Vert support only
Costing for each 2500 SF Unit, Suspended Lay-in Acoustic Tile Ceiling, Support: Vertical hanging wires only. Includes lighting fixtures in suspended ceiling.

Line 404

Construction Quality:	Normal			
Seismic Installation Conditions:	SDC A, B, or C			
Fragility Unit of Measure:	SF 2500			
Demand Parameter (unit):	Peak Floor Acceleration g			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	5 % of ceiling grid and tile damage.	30% of ceiling grid and tile damage.	50% of ceiling grid and tile damage.	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	Yes	

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	0.56	1.08	1.31	
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified	
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified	
Total Dispersion, β :	0.25	0.25	0.25	
Correlation (Yes / No)	NO	Data Quality Marginal	Documentation Quality Marginal	
Directionality (Yes / No)	NO	Data Relevance Superior	Rationality Average	

Consequence Functions

Repair Description	Reinstall, repair, or replace 5% of the ceiling area.	Replace 30% of the ceiling area.	Replace the entire ceiling
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Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.00E+03	3.63E+03	6.00E+03	1.35E+04	2.84E+04	5.35E+04	4.69E+04	5.84E+04	7.79E+04						
Best fit mean:	3.54E+03			2.76E+04			5.97E+04								
Best Fit Distribution:	Normal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00		10.00	1.00		10.00	1.00		10.00						
Average Repair Cost (Min Qty, Max Qty)	4.35E+03		2.90E+03	3.41E+04		2.27E+04	7.01E+04		4.67E+04						
CV or beta (Min Qty, Max Qty)	0.55		0.55	0.52		0.52	0.20		0.20						
Quantity Unit:	2500 ft^2 Units			2500 ft^2 Units			2500 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	7.50E-01	3.00E+00	5.00E+00	1.15E+01	2.43E+01	4.58E+01	4.00E+01	4.98E+01	6.65E+01						
Best fit mean:	3.00E+00			2.43E+01			4.98E+01								
Best Fit Distribution:	Normal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00		10.00	1.00		10.00	1.00		10.00						
Average Repair Time (Min Qty, Max Qty)	3.62E+00		2.38E+00	2.91E+01		1.94E+01	5.97E+01		3.98E+01						
CV or beta (Min Qty, Max Qty)	0.60		0.60	0.58		0.58	0.32		0.32						
Quantity Unit:	2500 ft^2 Units			2500 ft^2 Units			2500 ft^2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.2E+03	Normal	0.60	2.1E+04	LogNormal	0.58	8.2E+04	LogNormal	0.32						
Embodied Energy (MJ)	2.2E+04	Normal	0.60	2.9E+05	LogNormal	0.58	8.1E+05	LogNormal	0.32						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			YES								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			2500 SF								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		10%	0.50							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		75%	0.50		50%	0.50							

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2015-07-28 Update median demand and dispersion beta. 2015-08-21 Added SDC C

Root Cost Multiplier: 2500
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

C3032.003a

Line 405

NISTIR Name
Description

Suspended Ceiling, SDC D,E (Ip=1.0), Area (A): A < 250, Vert & Lat support
Costing for each 250 SF Unit, Suspended Lay-in Acoustic Tile Ceiling, Support: Vertical hanging wire, diagonal wires, and compression posts, 2 inch wide ledger support angles at wall and oversize holes around tile openings. Includes lighting fixtures in suspended ceiling.

Construction Quality:

Normal

Seismic Installation Conditions:

SDC D or E (Ip = 1.0)

Fragility Unit of Measure:

SF 250

Demand Parameter (unit):

Peak Floor Acceleration g

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

5 % of ceiling grid and tile damage.

30% of ceiling grid and tile damage.

50% of ceiling grid and tile damage.

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:

Fragility Parameters

Median Demand, θ :

1.6

1.95

2.07

Data dispersion, β_d :

Not Specified

Not Specified

Not Specified

Uncertainty, β_u :

Not Specified

Not Specified

Not Specified

Total Dispersion, β :

0.3

0.3

0.3

Correlation (Yes / No)

NO

Data Quality Marginal

Documentation Quality Marginal

Directionality (Yes / No)

NO

Data Relevance Superior

Rationality Average

Consequence Functions

Repair Description

Reinstall, repair, or replace 5% of the ceiling area.

Replace 30% of the ceiling area.

Replace the entire ceiling

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Cost by Damage State:	1.00E+02	3.63E+02	6.00E+02	1.35E+03	2.84E+03	5.35E+03	4.69E+03	5.84E+03	7.79E+03						
Best fit mean:	3.54E+02 Normal			2.76E+03 LogNormal			5.97E+03 LogNormal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	1.00 10.00			1.00 10.00			1.00 10.00								
Average Repair Cost (Min Qty, Max Qty)	7.25E+02 2.18E+02			5.68E+03 1.70E+03			1.17E+04 3.50E+03								
CV or beta (Min Qty, Max Qty)	0.55 0.55			0.52 0.52			0.20 0.20								
Quantity Unit:	250 ft^2 Units			250 ft^2 Units			250 ft^2 Units								
Repair Time:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Time by Damage State:	1.00E-01	3.50E-01	5.75E-01	1.30E+00	2.70E+00	5.13E+00	4.48E+00	5.58E+00	7.45E+00						
Best fit mean:	3.50E-01 Normal			2.70E+00 LogNormal			5.58E+00 LogNormal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	1.00 10.00			1.00 10.00			1.00 10.00								
Average Repair Time (Min Qty, Max Qty)	6.97E-01 2.11E-01			5.41E+00 1.62E+00			1.12E+01 3.34E+00								
CV or beta (Min Qty, Max Qty)	0.60 0.60			0.58 0.58			0.32 0.32								
Quantity Unit:	250 ft^2 Units			250 ft^2 Units			250 ft^2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.2E+02	Normal	0.60	2.1E+03	LogNormal	0.58	8.2E+03	LogNormal	0.32						
Embodied Energy (MJ)	2.2E+03	Normal	0.60	2.9E+04	LogNormal	0.58	8.1E+04	LogNormal	0.32						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			YES								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			250 SF								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		10%	0.50							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			NO								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2015-07-28 Update median demand and dispersion beta.

Root Cost Multiplier: 250

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

C3032.003b

Line 406

NISTIR Name
Description

Suspended Ceiling, SDC D,E (Ip=1.0), Area (A): 250 < A < 1000, Vert & Lat support
Costing for each 600 SF Unit, Suspended Lay-in Acoustic Tile Ceiling, Support: Vertical hanging wire, diagonal wires, and compression posts, 2 inch wide ledger support angles at wall and oversize holes around tile openings. Includes lighting fixtures in suspended ceiling.

Construction Quality:

Normal

Seismic Installation Conditions:

SDC D or E (Ip = 1.0)

Fragility Unit of Measure:

SF 600

Demand Parameter (unit):

Peak Floor Acceleration g

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

5 % of ceiling grid and tile damage.

30% of ceiling grid and tile damage.

50% of ceiling grid and tile damage.

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:

Fragility Parameters

Median Demand, θ :

1.47

Data dispersion, β_d :

Not Specified

Uncertainty, β_u :

Not Specified

Total Dispersion, β :

0.3

1.88

Not Specified

Not Specified

0.3

2.03

Not Specified

Not Specified

0.3

Correlation (Yes / No)

NO

Directionality (Yes / No)

NO

Data Quality Marginal

Data Relevance Superior

Documentation Quality Marginal

Rationality Average

Consequence Functions

Repair Description

Reinstall, repair, or replace 5% of the ceiling area.

Replace 30% of the ceiling area.

Replace the entire ceiling

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Cost by Damage State:	2.40E+02	8.70E+02	1.44E+03	3.24E+03	6.81E+03	1.28E+04	1.13E+04	1.40E+04	1.87E+04						
Best fit mean:	8.50E+02 Normal			6.63E+03 LogNormal			1.43E+04 LogNormal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	1.00 10.00			1.00 10.00			1.00 10.00								
Average Repair Cost (Min Qty, Max Qty)	1.74E+03 5.22E+02			1.36E+04 4.09E+03			2.80E+04 8.41E+03								
CV or beta (Min Qty, Max Qty)	0.55 0.55			0.52 0.52			0.20 0.20								
Quantity Unit:	600 ft^2 Units			600 ft^2 Units			600 ft^2 Units								
Repair Time:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Time by Damage State:	2.40E-01	7.80E-01	1.32E+00	2.94E+00	6.18E+00	1.17E+01	1.03E+01	1.28E+01	1.70E+01						
Best fit mean:	7.80E-01 Normal			6.18E+00 LogNormal			1.28E+01 LogNormal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	1.00 10.00			1.00 10.00			1.00 10.00								
Average Repair Time (Min Qty, Max Qty)	1.57E+00 4.63E-01			1.24E+01 3.70E+00			2.56E+01 7.67E+00								
CV or beta (Min Qty, Max Qty)	0.60 0.60			0.58 0.58			0.32 0.32								
Quantity Unit:	600 ft^2 Units			600 ft^2 Units			600 ft^2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	5.2E+02	Normal	0.60	5.1E+03	LogNormal	0.58	2.0E+04	LogNormal	0.32						
Embodied Energy (MJ)	5.2E+03	Normal	0.60	6.9E+04	LogNormal	0.58	1.9E+05	LogNormal	0.32						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			YES								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			650 SF								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		10%	0.50							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			NO								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2015-07-28 Update median demand and dispersion beta.

Root Cost Multiplier: 600

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

C3032.003c

Line 407

NISTIR Name
Description

Suspended Ceiling, SDC D,E (Ip=1.0), Area (A): 1000 < A < 2500, Vert & Lat support
Costing for each 1800 SF Unit, Suspended Lay-in Acoustic Tile Ceiling, Support: Vertical hanging wire, diagonal wires, and compression posts, 2 inch wide ledger support angles at wall and oversize holes around tile openings. Includes lighting fixtures in suspended ceiling.

Construction Quality:
Seismic Installation Conditions:

Normal
SDC D or E (Ip = 1.0)

Fragility Unit of Measure:

SF 1800

Demand Parameter (unit):

Peak Floor Acceleration g

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

5 % of ceiling grid and tile damage.

30% of ceiling grid and tile damage.

50% of ceiling grid and tile damage.

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:

Fragility Parameters

Median Demand, θ :

1.21

1.75

1.95

Data dispersion, β_d :

Not Specified

Not Specified

Not Specified

Uncertainty, β_u :

Not Specified

Not Specified

Not Specified

Total Dispersion, β :

0.3

0.3

0.3

Correlation (Yes / No)

NO

Directionality (Yes / No)

NO

Data Quality Marginal

Data Relevance Superior

Documentation Quality Marginal

Rationality Average

Consequence Functions

Repair Description

Reinstall, repair, or replace 5% of the ceiling area.

Replace 30% of the ceiling area.

Replace the entire ceiling

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	7.20E+02	2.61E+03	4.32E+03	9.72E+03	2.04E+04	3.85E+04	3.38E+04	4.20E+04	5.61E+04						
Best fit mean:	2.55E+03			1.99E+04			4.30E+04								
Best Fit Distribution:	Normal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00 10.00			1.00 10.00			1.00 10.00								
Average Repair Cost (Min Qty, Max Qty)	5.22E+03 1.57E+03			4.09E+04 1.23E+04			8.41E+04 2.52E+04								
CV or beta (Min Qty, Max Qty)	0.55 0.55			0.52 0.52			0.20 0.20								
Quantity Unit:	1800 ft^2 Units			1800 ft^2 Units			1800 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	7.20E-01	2.34E+00	3.78E+00	8.64E+00	1.80E+01	3.40E+01	2.97E+01	3.71E+01	4.95E+01						
Best fit mean:	2.34E+00			1.80E+01			3.71E+01								
Best Fit Distribution:	Normal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00 10.00			1.00 10.00			1.00 10.00								
Average Repair Time (Min Qty, Max Qty)	4.64E+00 1.42E+00			3.60E+01 1.08E+01			7.42E+01 2.22E+01								
CV or beta (Min Qty, Max Qty)	0.60 0.60			0.58 0.58			0.32 0.32								
Quantity Unit:	1800 ft^2 Units			1800 ft^2 Units			1800 ft^2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.6E+03	Normal	0.60	1.5E+04	LogNormal	0.58	5.9E+04	LogNormal	0.32						
Embodied Energy (MJ)	1.6E+04	Normal	0.60	2.1E+05	LogNormal	0.58	5.8E+05	LogNormal	0.32						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			YES								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			1700 SF								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		10%	0.50							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			NO								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2015-07-28 Update median demand and dispersion data.

Root Cost Multiplier: 1800

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

C3032.003d

Line 408

NISTIR Name
Description

Suspended Ceiling, SDC D,E (Ip=1.0), Area (A): A > 2500, Vert & Lat support
Costing for each 2500 SF Unit, Suspended Lay-in Acoustic Tile Ceiling, Support: Vertical hanging wire, diagonal wires, and compression posts, 2 inch wide ledger support angles at wall and oversize holes around tile openings. Includes lighting fixtures in suspended ceiling.

Construction Quality:

Normal

Seismic Installation Conditions:

SDC D or E (Ip = 1.0)

Fragility Unit of Measure:

SF 2500

Demand Parameter (unit):

Peak Floor Acceleration g

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

5 % of ceiling grid and tile damage.

30% of ceiling grid and tile damage.

50% of ceiling grid and tile damage.

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:

Fragility Parameters

Median Demand, θ :

1.09

1.69

1.91

Data dispersion, β_d :

Not Specified

Not Specified

Not Specified

Uncertainty, β_u :

Not Specified

Not Specified

Not Specified

Total Dispersion, β :

0.3

0.3

0.3

Correlation (Yes / No)

NO

Directionality (Yes / No)

NO

Data Quality Marginal

Documentation Quality Marginal

Data Relevance Superior

Rationality Average

Consequence Functions

Repair Description

Reinstall, repair, or replace 5% of the ceiling area.

Replace 30% of the ceiling area.

Replace the entire ceiling

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Cost by Damage State:	1.00E+03	3.63E+03	6.00E+03	1.35E+04	2.84E+04	5.35E+04	4.69E+04	5.84E+04	7.79E+04						
Best fit mean:	3.54E+03 Normal			2.76E+04 LogNormal			5.97E+04 LogNormal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	1.00 10.00			1.00 10.00			1.00 10.00								
Average Repair Cost (Min Qty, Max Qty)	7.25E+03 2.18E+03			5.68E+04 1.70E+04			1.17E+05 3.50E+04								
CV or beta (Min Qty, Max Qty)	0.55 0.55			0.52 0.52			0.20 0.20								
Quantity Unit:	2500 ft^2 Units			2500 ft^2 Units			2500 ft^2 Units								
Repair Time:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Time by Damage State:	7.50E-01	3.00E+00	5.00E+00	1.15E+01	2.43E+01	4.58E+01	4.00E+01	4.98E+01	6.65E+01						
Best fit mean:	3.00E+00 Normal			2.43E+01 LogNormal			4.98E+01 LogNormal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	1.00 10.00			1.00 10.00			1.00 10.00								
Average Repair Time (Min Qty, Max Qty)	6.09E+00 1.76E+00			4.85E+01 1.46E+01			9.95E+01 2.98E+01								
CV or beta (Min Qty, Max Qty)	0.60 0.60			0.58 0.58			0.32 0.32								
Quantity Unit:	2500 ft^2 Units			2500 ft^2 Units			2500 ft^2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.2E+03	Normal	0.60	2.1E+04	LogNormal	0.58	8.2E+04	LogNormal	0.32						
Embodied Energy (MJ)	2.2E+04	Normal	0.60	2.9E+05	LogNormal	0.58	8.1E+05	LogNormal	0.32						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			YES								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			2500 SF								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		10%	0.50							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		75%	0.50		50%	0.50							

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2015-07-28 Update median demand and dispersion beta.

Root Cost Multiplier: 2500

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

C3032.004a

Line 409

NISTIR Name
Description

Suspended Ceiling, SDC D,E,F (Ip=1.5), Area (A): A < 250, Vert & Lat support
Costing for each 250 SF Unit, Suspended Lay-in Acoustic Tile Ceiling, Support: Vertical hanging wire, diagonal wires, and compression posts, 2 inch wide ledger support angles at wall and oversize holes around tile openings. Includes lighting fixtures in suspended ceiling.

Construction Quality:

Special Inspection (e.g. OSHPD)

Seismic Installation Conditions:

SDC D, E or F (Ip = 1.5)

Fragility Unit of Measure:

SF 250

Demand Parameter (unit):

Peak Floor Acceleration g

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1.DS2.DS3)

Descriptions

5 % of ceiling grid and tile damage.

30% of ceiling grid and tile damage.

50% of ceiling grid and tile damage.

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:

Fragility Parameters

Median Demand, θ :

1.92

2.34

2.48

Data dispersion, β_d :

Not Specified

Not Specified

Not Specified

Uncertainty, β_u :

Not Specified

Not Specified

Not Specified

Total Dispersion, β :

0.3

0.3

0.3

Correlation (Yes / No)

NO

Data Quality Marginal

Documentation Quality Marginal

Directionality (Yes / No)

NO

Data Relevance Superior

Rationality Average

Consequence Functions

Repair Description

Reinstall, repair, or replace 5% of the ceiling area.

Replace 30% of the ceiling area.

Replace the entire ceiling

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.00E+02	3.63E+02	6.00E+02	1.35E+03	2.84E+03	5.35E+03	4.69E+03	5.84E+03	7.79E+03						
Best fit mean:	3.54E+02			2.76E+03			5.97E+03								
Best Fit Distribution:	Normal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00		10.00	1.00		10.00	1.00		10.00						
Average Repair Cost (Min Qty, Max Qty)	7.25E+02		2.18E+02	5.68E+03		1.70E+03	1.17E+04		3.50E+03						
CV or beta (Min Qty, Max Qty)	0.55		0.55	0.52		0.52	0.20		0.20						
Quantity Unit:	250 ft^2 Units			250 ft^2 Units			250 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.00E-01	3.50E-01	5.75E-01	1.30E+00	2.70E+00	5.13E+00	4.48E+00	5.58E+00	7.45E+00						
Best fit mean:	3.50E-01			2.70E+00			5.58E+00								
Best Fit Distribution:	Normal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00		10.00	1.00		10.00	1.00		10.00						
Average Repair Time (Min Qty, Max Qty)	6.97E-01		2.11E-01	5.41E+00		1.62E+00	1.12E+01		3.34E+00						
CV or beta (Min Qty, Max Qty)	0.60		0.60	0.58		0.58	0.32		0.32						
Quantity Unit:	250 ft^2 Units			250 ft^2 Units			250 ft^2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.2E+02	Normal	0.60	2.1E+03	LogNormal	0.58	8.2E+03	LogNormal	0.32						
Embodied Energy (MJ)	2.2E+03	Normal	0.60	2.9E+04	LogNormal	0.58	8.1E+04	LogNormal	0.32						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			YES								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			250 SF								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		10%	0.50							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			NO								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2015-07-28 Update median demand and dispersion beta.

Root Cost Multiplier: 250

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

C3032.004b

Line 410

NISTIR Name
Description

Suspended Ceiling, SDC D,E,F (Ip=1.5), Area (A): 250 < A < 1000, Vert & Lat support
Costing for each 600 SF Unit, Suspended Lay-in Acoustic Tile Ceiling, Support: Vertical hanging wire, diagonal wires, and compression posts, 2 inch wide ledger support angles at wall and oversize holes around tile openings. Includes lighting fixtures in suspended ceiling.

Construction Quality:

Special Inspection (e.g. OSHPD)

Seismic Installation Conditions:

SDC D, E or F (Ip = 1.5)

Fragility Unit of Measure:

SF 600

Demand Parameter (unit):

Peak Floor Acceleration g

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

5 % of ceiling grid and tile damage.

30% of ceiling grid and tile damage.

50% of ceiling grid and tile damage.

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	Yes	

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:

Fragility Parameters

Median Demand, θ :

1.76

Data dispersion, β_d :

Not Specified

2.26

Not Specified

2.44

Not Specified

Uncertainty, β_u :

Not Specified

Not Specified

Not Specified

Total Dispersion, β_t :

0.3

0.3

0.3

Correlation (Yes / No)

NO

Data Quality Marginal

Documentation Quality Marginal

Directionality (Yes / No)

NO

Data Relevance Superior

Rationality Average

Consequence Functions

Repair Description

Reinstall, repair, or replace 5% of the ceiling area.

Replace 30% of the ceiling area.

Replace the entire ceiling

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Cost by Damage State:	2.40E+02	8.70E+02	1.44E+03	3.24E+03	6.81E+03	1.28E+04	1.13E+04	1.40E+04	1.87E+04						
Best fit mean:	8.50E+02			6.63E+03			1.43E+04								
Best Fit Distribution:	Normal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00 10.00			1.00 10.00			1.00 10.00								
Average Repair Cost (Min Qty, Max Qty)	1.74E+03 5.22E+02			1.36E+04 4.09E+03			2.80E+04 8.41E+03								
CV or beta (Min Qty, Max Qty)	0.55 0.55			0.52 0.52			0.20 0.20								
Quantity Unit:	600 ft^2 Units			600 ft^2 Units			600 ft^2 Units								
Repair Time:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Time by Damage State:	2.40E-01	7.80E-01	1.32E+00	2.94E+00	6.18E+00	1.17E+01	1.03E+01	1.28E+01	1.70E+01						
Best fit mean:	7.80E-01			6.18E+00			1.28E+01								
Best Fit Distribution:	Normal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00 10.00			1.00 10.00			1.00 10.00								
Average Repair Time (Min Qty, Max Qty)	1.57E+00 4.63E-01			1.24E+01 3.70E+00			2.56E+01 7.67E+00								
CV or beta (Min Qty, Max Qty)	0.60 0.60			0.58 0.58			0.32 0.32								
Quantity Unit:	600 ft^2 Units			600 ft^2 Units			600 ft^2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	5.2E+02	Normal	0.60	5.1E+03	LogNormal	0.58	2.0E+04	LogNormal	0.32						
Embodied Energy (MJ)	5.2E+03	Normal	0.60	6.9E+04	LogNormal	0.58	1.9E+05	LogNormal	0.32						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			YES								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			650 SF								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		10%	0.50							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			NO								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2015-07-28 Update median demand and dispersion beta.

Root Cost Multiplier: 600

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

C3032.004c

Line 411

NISTIR Name
Description

Suspended Ceiling, SDC D,E,F (Ip=1.5), Area (A): 1000 < A < 2500, Vert & Lat support
Costing for each 1800 SF Unit, Suspended Lay-in Acoustic Tile Ceiling, Support: Vertical hanging wire, diagonal wires, and compression posts, 2 inch wide ledger support angles at wall and oversize holes around tile openings. Includes lighting fixtures in suspended ceiling.

Construction Quality:
Seismic Installation Conditions:

Special Inspection (e.g. OSHPD)
SDC D, E or F (Ip = 1.5)

Fragility Unit of Measure:	SF 1800
Demand Parameter (unit):	Peak Floor Acceleration g
Number of Damage States:	3

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	Yes	

Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1.DS2.DS3)				
Descriptions	5 % of ceiling grid and tile damage.	30% of ceiling grid and tile damage.	50% of ceiling grid and tile damage.		

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	1.45	2.1	2.34		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified		
Total Dispersion, β :	0.3	0.3	0.3		
Correlation (Yes / No)	NO	Data Quality Marginal	Documentation Quality Marginal		
Directionality (Yes / No)	NO	Data Relevance Superior	Rationality Average		

Consequence Functions
Repair Description

Reinstall, repair, or replace 5% of the ceiling area.
Replace 30% of the ceiling area.
Replace the entire ceiling

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	7.20E+02	2.61E+03	4.32E+03	9.72E+03	2.04E+04	3.85E+04	3.38E+04	4.20E+04	5.61E+04						
Best fit mean:	2.55E+03			1.99E+04			4.30E+04								
Best Fit Distribution:	Normal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00		10.00	1.00		10.00	1.00		10.00						
Average Repair Cost (Min Qty, Max Qty)	5.22E+03		1.57E+03	4.09E+04		1.23E+04	8.41E+04		2.52E+04						
CV or beta (Min Qty, Max Qty)	0.55		0.55	0.52		0.52	0.20		0.20						
Quantity Unit:	1800 ft^2 Units			1800 ft^2 Units			1800 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	7.20E-01	2.34E+00	3.78E+00	8.64E+00	1.80E+01	3.40E+01	2.97E+01	3.71E+01	4.95E+01						
Best fit mean:	2.34E+00			1.80E+01			3.71E+01								
Best Fit Distribution:	Normal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00		10.00	1.00		10.00	1.00		10.00						
Average Repair Time (Min Qty, Max Qty)	4.64E+00		1.42E+00	3.60E+01		1.08E+01	7.42E+01		2.22E+01						
CV or beta (Min Qty, Max Qty)	0.60		0.60	0.58		0.58	0.32		0.32						
Quantity Unit:	1800 ft^2 Units			1800 ft^2 Units			1800 ft^2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.6E+03	Normal	0.60	1.5E+04	LogNormal	0.58	5.9E+04	LogNormal	0.32						
Embodied Energy (MJ)	1.6E+04	Normal	0.60	2.1E+05	LogNormal	0.58	5.8E+05	LogNormal	0.32						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			YES								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			1700 SF								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		10%	0.50							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			NO								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							

Comments:

None
Not Given
By User
By User
Not Given
2015-07-28 Update median demand and dispersion data.

Root Cost Multiplier: 1800
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

C3032.004d

Line 412

NISTIR Name
Description

Suspended Ceiling, SDC D,E,F (I_p=1.5), Area (A): A > 2500, Vert & Lat support
Costing for each 2500 SF Unit, Suspended Lay-in Acoustic Tile Ceiling, Support: Vertical hanging wire, diagonal wires, and compression posts, 2 inch wide ledger support angles at wall and oversize holes around tile openings. Includes lighting fixtures in suspended ceiling.

Construction Quality:
Seismic Installation Conditions:

Special Inspection (e.g. OSHPD)
SDC D, E or F (I_p = 1.5)

Fragility Unit of Measure:	SF 2500
Demand Parameter (unit):	Peak Floor Acceleration g
Number of Damage States:	3

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1.DS2.DS3)				
Descriptions	5 % of ceiling grid and tile damage.	30% of ceiling grid and tile damage.	50% of ceiling grid and tile damage.		

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:

Fragility Parameters					
Median Demand, θ :	1.31	2.03	2.29		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified		
Total Dispersion, β :	0.3	0.3	0.3		

Correlation (Yes / No)	NO	Data Quality Marginal	Documentation Quality Marginal
Directionality (Yes / No)	NO	Data Relevance Superior	Rationality Average

Consequence Functions

Repair Description	Reinstall, repair, or replace 5% of the ceiling area.	Replace 30% of the ceiling area.	Replace the entire ceiling
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Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.00E+03	3.63E+03	6.00E+03	1.35E+04	2.84E+04	5.35E+04	4.69E+04	5.84E+04	7.79E+04						
Best fit mean:	3.54E+03			2.76E+04			5.97E+04								
Best Fit Distribution:	Normal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00 10.00			1.00 10.00			1.00 10.00								
Average Repair Cost (Min Qty, Max Qty)	7.25E+03 2.18E+03			5.68E+04 1.70E+04			1.17E+05 3.50E+04								
CV or beta (Min Qty, Max Qty)	0.55 0.55			0.52 0.52			0.20 0.20								
Quantity Unit:	2500 ft^2 Units			2500 ft^2 Units			2500 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	7.50E-01	3.00E+00	5.00E+00	1.15E+01	2.43E+01	4.58E+01	4.00E+01	4.98E+01	6.65E+01						
Best fit mean:	3.00E+00			2.43E+01			4.98E+01								
Best Fit Distribution:	Normal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00 10.00			1.00 10.00			1.00 10.00								
Average Repair Time (Min Qty, Max Qty)	6.09E+00 1.76E+00			4.85E+01 1.46E+01			9.95E+01 2.98E+01								
CV or beta (Min Qty, Max Qty)	0.60 0.60			0.58 0.58			0.32 0.32								
Quantity Unit:	2500 ft^2 Units			2500 ft^2 Units			2500 ft^2 Units								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.2E+03	Normal	0.60	2.1E+04	LogNormal	0.58	8.2E+04	LogNormal	0.32						
Embodied Energy (MJ)	2.2E+04	Normal	0.60	2.9E+05	LogNormal	0.58	8.1E+05	LogNormal	0.32						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			YES								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			2500 SF								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		10%	0.50							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		75%	0.50		50%	0.50							

Comments:

None

Date Created:
Approved (YES / NO)?
Official (YES / NO) ?

Not Given
By User
By User

Author:

Not Given

Revisions:

2015-07-28 Update median demand and dispersion beta.

Root Cost Multiplier: 2500
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

C3034.001

NISTIR Name
Description

Independent Pendant Lighting - non seismic
Horizontal light fixtures 4 to 16 ft long suspended 12 to 24 inches from ceiling. No seismic design or bracing. Hung from ceiling above by two or more rods or cables.

Line 413

Construction Quality: Normal
Seismic Installation Conditions: All

Fragility Unit of Measure:	EA 1
Demand Parameter (unit):	Peak Floor Acceleration g
Number of Damage States:	1

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	Yes	

Damage State:	DS1				
Type of Damage State:	Sequential				
DS Hierarchy	Seq(DS1)				
Descriptions	Disassembly of rod system at connections with horizontal light fixture, low cycle fatigue failure of the threaded rod, pullout of rods from ceiling assembly.				

Illustrations

none				
1.00				

Damage State Probability:

Fragility Parameters					
Median Demand, θ :	0.6				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	Not Specified				
Total Dispersion, β :	0.4				

Correlation (Yes / No) NO Data Quality Not Rated Documentation Quality Not Rated
Directionality (Yes / No) NO Data Relevance Not Rated Rationality Not Rated

Consequence Functions
Repair Description

Replace damaged lighting components.

Long Lead Time (Yes / No)

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.00E+02	4.95E+02	1.09E+03												
Best fit mean:	4.83E+02														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	5.00		10.00												
Average Repair Cost (Min Qty, Max Qty)	2.30E+00		6.90E-01												
CV or beta (Min Qty, Max Qty)	0.64		0.64												
Quantity Unit:	Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	4.00E-04	1.10E-03	6.10E-03												
Best fit mean:	1.10E-03														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	5.00		10.00												
Average Repair Time (Min Qty, Max Qty)	2.25E-03		6.40E-04												
CV or beta (Min Qty, Max Qty)	0.68		0.68												
Quantity Unit:	Each														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	5.2E+01	LogNormal	0.68												
Embodied Energy (MJ)	1.0E+03	LogNormal	0.68												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	YES														
Casualty-affected Planar Area (sf) per Normative Unit:	100 SF														
Serious Injury (Median, Dispersion)	75%	0.50													
Loss of Life (Median, Dispersion)	25%	0.50													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments: Low cost industrial hung lighting in warehouse or gymnasium that is not part of suspended ceiling or hanging from a suspended ceiling space.
Date Created: Not Given Root Cost Multiplier: 1
Approved (YES / NO)? By User Date Generated: 02/26/19
Official (YES / NO) ? By User
Author: Not Given
Revisions: None

FEMA P-58 Fragility Specification

NISTIR Classification

C3034.002

Line 414

NISTIR Name
Description

Independent Pendant Lighting - seismically rated
Horizontal light fixtures 4 to 16 ft long suspended 12 to 24 inches from ceiling. Hung from ceiling above by two or more rods or cables. Fixture and rods or cables are either designed for seismic movements or are laterally braced to prevent sway.

Construction Quality:
Seismic Installation Conditions:

Normal
All

Fragility Unit of Measure:	EA 1
Demand Parameter (unit):	Peak Floor Acceleration g
Number of Damage States:	1

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	Yes	

Damage State:	DS1				
Type of Damage State:	Sequential				
DS Hierarchy	Seq(DS1)				
Descriptions	Disassembly of rod system at connections with horizontal light fixture, low cycle fatigue failure of the threaded rod, pullout of rods from ceiling assembly.				

Illustrations

none				
1.00				

Damage State Probability:

Fragility Parameters					
Median Demand, θ :	1.5				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	Not Specified				
Total Dispersion, β :	0.4				

Correlation (Yes / No)	NO	Data Quality	Not Rated	Documentation Quality	Not Rated
Directionality (Yes / No)	NO	Data Relevance	Not Rated	Rationality	Not Rated

Consequence Functions
Repair Description

Replace damaged lighting components.

Long Lead Time (Yes / No)

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.00E+02	4.95E+02	1.09E+03												
Best fit mean:	4.83E+02														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	5.00		10.00												
Average Repair Cost (Min Qty, Max Qty)	9.90E+02		2.97E+02												
CV or beta (Min Qty, Max Qty)	0.64		0.64												
Quantity Unit:	Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.00E-01	4.95E-01	1.09E+00												
Best fit mean:	4.95E-01														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	5.00		10.00												
Average Repair Time (Min Qty, Max Qty)	9.90E-01		2.97E-01												
CV or beta (Min Qty, Max Qty)	0.68		0.68												
Quantity Unit:	Each														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	5.2E+01	LogNormal	0.68												
Embodied Energy (MJ)	1.0E+03	LogNormal	0.68												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments:

Low cost industrial hung lighting in warehouse or gymnasium that is not part of suspended ceiling or hanging from a suspended ceiling space.

Date Created:
Approved (YES / NO)?
Official (YES / NO) ?
Author:
Revisions:

Not Given
By User
By User
Not Given
None

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

D1014.011

NISTIR Name
Description

Traction Elevator – Applies to most California Installations 1976 or later, most western states installations 1982 or later and most other U.S installations 1998 or later.
Costing per elevator. Elevator demand parameter shall be defined as the peak floor acceleration at the first floor. The elevator fragility for a multiple story building should only be entered once on the first floor.

Line 415




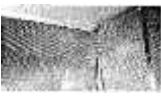
Construction Quality: Any
Seismic Installation Conditions: Any

Fragility Unit of Measure:	EA 1
Demand Parameter (unit):	Peak Floor Acceleration g
Number of Damage States:	4

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?	BLDG	
Demand Location (floor above?)	No	

Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Simultaneous	Simultaneous	Simultaneous	Simultaneous	
DS Hierarchy	Simul(DS1,DS2,DS3,DS4)				
Descriptions	Simultaneous Controller anchorage failed, and/or machine anchorage failed, and/or generator anchorage failed, and/or governor anchorage failed, and/or rope guard failures.	Rail distortion, and/or intermediate bracket separate and spread, and/or counterweight bracket break or bend, and/or car bracket break or bend, and/or car guide shoes damaged, and/or counterweight guide shoes damaged, and/or counterweight frame distortion, and/or tail sheave dislodged and/or twisted	Cab stabilizers bent, or cab walls damaged, or cab doors damaged.	Cab ceiling damaged.	

Illustrations

				
D1014.010-DS1-1.JPG	D1014.010-DS2-6.JPG	none	D1014.010-DS4-1.JPG	
0.26	0.79	0.68	0.17	

Damage State Probability:	0.26	0.79	0.68	0.17	
Fragility Parameters					
Median Demand, θ :	0.39	0.39	0.39	0.39	
Data dispersion, β_d :	0.4	Not Specified	Not Specified	Not Specified	
Uncertainty, β_u :	0.1	Not Specified	Not Specified	Not Specified	
Total Dispersion, β_t :	0.45	0.45	0.45	0.45	
Correlation (Yes / No)	NO	Data Quality	Not Rated	Documentation Quality	Not Rated
Directionality (Yes / No)	NO	Data Relevance	Not Rated	Rationality	Not Rated

Consequence Functions
Repair Description

Multiple repairs possible (% change of each):
Reinstall or replace controller (4%), and/or reinstall or replace motor generator (63%), and/or install new generator with appropriate anchors (23%), and/or install new governor (7%), and/or Reinstall or replace rope guards (15%).

Multiple repairs possible (% change of each):
Replace rail (62%), and/or replace bracket or tie rod (28%), and/or replace counterweight bracket (14%), and/or replace intermediate bracket (28%), and/or replace car guide shoes (35%), and/or replace counterweight guide shoe (28%), and/or repair or replace counterweight frame (28%), and/or repair or replace tail sheave (13%).

Multiple repairs possible (% change of each):
Repair or replace cab walls (3%), and/or repair or replace cab doors (17%), and/or repair or replace cab stabilizers (92%).

Multiple repairs possible (% change of each):
Repair or replace cab ceiling (100%).

Long Lead Time (Yes / No)

YES YES YES YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.50E+03	4.40E+03	1.36E+04	1.14E+04	1.87E+04	2.43E+04	6.00E+03	1.60E+04	2.10E+04	5.00E+02	2.50E+03	3.00E+03			
Best fit mean:	4.43E+03			1.81E+04			1.43E+04			2.00E+03					
Best Fit Distribution:	LogNormal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00			5.00			10.00		
Average Repair Cost (Min Qty, Max Qty)	8.80E+03			3.74E+04			3.20E+04			5.00E+03			1.50E+03		
CV or beta (Min Qty, Max Qty)	0.87			0.28			0.41			0.49			0.49		
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.43E+00	4.21E+00	1.30E+01	1.09E+01	1.79E+01	2.32E+01	5.74E+00	1.53E+01	2.01E+01	4.78E-01	2.39E+00	2.87E+00			
Best fit mean:	4.21E+00			1.79E+01			1.53E+01			2.39E+00					
Best Fit Distribution:	LogNormal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00			5.00			10.00		
Average Repair Time (Min Qty, Max Qty)	8.41E+00			3.58E+01			3.06E+01			4.78E+00			1.43E+00		
CV or beta (Min Qty, Max Qty)	0.91			0.37			0.48			0.55			0.55		
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	3.8E+02	LogNormal	0.91	1.6E+03	Normal	0.37	2.7E+03	Normal	0.48	4.3E+02	Normal	0.55			
Embodied Energy (MJ)	9.5E+03	LogNormal	0.91	4.0E+04	Normal	0.37	6.9E+04	Normal	0.48	1.1E+04	Normal	0.55			
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			YES					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			40 SF					
Serious Injury (Median, Dispersion)	0%			0%			0%			10%			0.50		
Loss of Life (Median, Dispersion)	0%			0%			0%			5%			0.50		
Post-event Tagging Flag:	NO			NO			NO			NO					
Unsafe Placard Trigger (Median, Dispersion)	0%			0%			0%			0%			0.00		

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: None

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

D1014.012

NISTIR Name

Traction Elevator – Applies to most California Installations prior to 1976, most western states installations prior to 1982 and most other U.S installations prior to 1998. Costing per elevator. Elevator demand parameter shall be defined as the peak floor acceleration at the first floor. The elevator fragility for a multiple story building should only be entered once on the first floor.

Construction Quality:

Any

Seismic Installation Conditions:

Any

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Peak Floor Acceleration g

Number of Damage States:

4

Damage State:

DS1

DS2

DS3

DS4

Type of Damage State:

Simultaneous

Simultaneous

Simultaneous

Simultaneous

DS Hierarchy

Simul(DS1,DS2,DS3,DS4)

Descriptions

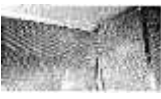
Controller anchorage failed, and/or machine anchorage failed, and/or generator anchorage failed, and/or governor anchorage failed, and/or rope guard failures.

Rail distortion, and/or intermediate bracket separate and spread, and/or counterweight bracket break or bend, and/or car bracket break or bend, and/or car guide shoes damaged, and/or counterweight guide shoes damaged, and/or counterweight frame distortion, and/or tail sheave dislodged and/or twisted

Cab stabilizers bent, or cab walls damaged, or cab doors damaged.

Cab ceiling damaged.

Illustrations

				
D1014.010-DS1-1.JPG	D1014.010-DS2-6.JPG	none	D1014.010-DS4-1.JPG	

Damage State Probability:

0.26

0.79

0.68

0.17

Fragility Parameters

Median Demand, θ :

0.31

0.31

0.31

0.31

Data dispersion, β_d :

Not Specified

Not Specified

Not Specified

Not Specified

Uncertainty, β_u :

Not Specified

Not Specified

Not Specified

Not Specified

Total Dispersion, β :

0.45

0.45

0.45

0.45

Correlation (Yes / No)

NO

Data Quality Not Rated

Documentation Quality Not Rated

Directionality (Yes / No)

NO

Data Relevance Not Rated

Rationality Not Rated

Consequence Functions

Repair Description

Multiple repairs possible (% change of each):
Reinstall or replace controller (4%), and/or reinstall or replace motor generator (63%), and/or install new generator with appropriate anchors (23%), and/or install new governor (7%), and/or Reinstall or replace rope guards (15%).

Multiple repairs possible (% change of each):
Replace rail (62%), and/or replace bracket or tie rod (28%), and/or replace counterweight bracket (14%), and/or replace intermediate bracket (28%), and/or replace car guide shoes (35%), and/or replace counterweight guide shoe (28%), and/or replace or replace counterweight frame (28%), and/or replace or replace tail sheave (13%).

Multiple repairs possible (% change of each):
Repair or replace cab walls (3%), and/or repair or replace cab doors (17%), and/or repair or replace cab stabilizers (92%).

Multiple repairs possible (% change of each):
Repair or replace cab ceiling (100%).

Long Lead Time (Yes / No)

YES

YES

YES

YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.50E+03	4.40E+03	1.36E+04	1.14E+04	1.87E+04	2.43E+04	6.00E+03	1.60E+04	2.10E+04	5.00E+02	2.50E+03	3.00E+03			
Best fit mean:	4.43E+03			1.81E+04			1.43E+04			2.00E+03					
Best Fit Distribution:	LogNormal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00			5.00			10.00		
Average Repair Cost (Min Qty, Max Qty)	8.80E+03			3.74E+04			3.20E+04			9.60E+03			5.00E+03		
CV or beta (Min Qty, Max Qty)	0.87			0.28			0.41			0.49			0.49		
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.43E+00	4.21E+00	1.30E+01	1.09E+01	1.79E+01	2.32E+01	5.74E+00	1.53E+01	2.01E+01	4.78E-01	2.39E+00	2.87E+00			
Best fit mean:	4.21E+00			1.79E+01			1.53E+01			2.39E+00					
Best Fit Distribution:	LogNormal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00			5.00			5.00			5.00			10.00		
Average Repair Time (Min Qty, Max Qty)	8.41E+00			3.58E+01			3.06E+01			9.18E+00			4.78E+00		
CV or beta (Min Qty, Max Qty)	0.91			0.37			0.48			0.55			0.55		
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	3.8E+02	LogNormal	0.91	1.6E+03	Normal	0.37	2.7E+03	Normal	0.48	4.3E+02	Normal	0.55			
Embodied Energy (MJ)	9.5E+03	LogNormal	0.91	4.0E+04	Normal	0.37	6.9E+04	Normal	0.48	1.1E+04	Normal	0.55			
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			YES					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			40 SF					
Serious Injury (Median, Dispersion)	0%			0%			0%			10%			0.50		
Loss of Life (Median, Dispersion)	0%			0%			0%			5%			0.50		
Post-event Tagging Flag:	NO			NO			NO			NO					
Unsafe Placard Trigger (Median, Dispersion)	0%			0%			0%			0%			0.00		

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

None

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

D1014.021

NISTIR Name
Description

Hydraulic Elevator – Applies to most California Installations 1976 or later, most western states installations postdating 1982 and most U.S installations postdating 1998.
Costing per elevator. Elevator demand parameter shall be defined as the peak floor acceleration at the first floor. The elevator fragility for a multiple story building should only be entered once on the first floor.

Line 417

Construction Quality:
Seismic Installation Conditions:

Any
Any

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Peak Floor Acceleration g

Quantity Rounding Round Qty? YES
Allow sum by floor or building? BLDG
Demand Location (floor above?) No

Number of Damage States:

4

Damage State:

DS1

DS2

DS3

DS4

Type of Damage State:

Simultaneous

Simultaneous

Simultaneous

Simultaneous

DS Hierarchy

Simul(DS1,DS2,DS3,DS4)

Descriptions

Damaged controls.

Damaged vane and hoist-way switches, and or bent cab stabilizers, and or damaged car guide shoes.

Damaged entrance and car door, and or flooring damage.

Oil leak in hydraulic line, and or hydraulic tank failure.

Illustrations

none	none	none	none	
0.30	0.49	0.44	0.37	

Damage State Probability:

Fragility Parameters

Median Demand, θ :

0.5

0.5

0.5

0.5

Data dispersion, β_d :

0.28

Not Specified

Not Specified

Not Specified

Uncertainty, β_u :

0.1

Not Specified

Not Specified

Not Specified

Total Dispersion, β :

0.3

0.3

0.3

0.3

Correlation (Yes / No)

NO

Data Quality Not Rated

Documentation Quality Not Rated

Directionality (Yes / No)

NO

Data Relevance Not Rated

Rationality Not Rated

Consequence Functions

Repair Description

Multiple repairs possible (% change of each):
Repair damaged controls (100%)

Multiple repairs possible (% change of each):
Repair damaged vane and hoist-way switches (41%), and or repair bent cab stabilizers (41%), and or repair damaged car guide shoes (41%).

Multiple repairs possible (% change of each):
Repair damage to doors (68%), and or repair flooring (46%)

Multiple repairs possible (% change of each):
Repair oil leak in hydraulic line (27%), and or hydraulic tank failure (81%)

Long Lead Time (Yes / No)

NO

NO

YES

NO

Repair Costs:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Cost by Damage State:	4.00E+02	8.00E+02	2.50E+03	4.20E+03	8.20E+03	1.05E+04	4.00E+03	1.20E+04	1.60E+04	2.00E+03	2.30E+03	3.60E+03			
Best fit mean:	8.68E+02 LogNormal			7.63E+03 Normal			1.07E+04 Normal			2.54E+03 LogNormal					
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00			5.00 10.00			5.00 10.00					
Average Repair Cost (Min Qty, Max Qty)	1.60E+03 4.80E+02			1.64E+04 4.92E+03			2.40E+04 7.20E+03			4.60E+03 1.38E+03					
CV or beta (Min Qty, Max Qty)	0.82 0.82			0.32 0.32			0.44 0.44			0.25 0.25					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Time by Damage State:	3.82E-01	7.65E-01	2.39E+00	4.01E+00	7.84E+00	1.00E+01	3.82E+00	1.15E+01	1.53E+01	1.91E+00	2.20E+00	3.44E+00			
Best fit mean:	7.65E-01 LogNormal			7.84E+00 Normal			1.15E+01 Normal			2.20E+00 LogNormal					
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00			5.00 10.00			5.00 10.00					
Average Repair Time (Min Qty, Max Qty)	1.53E+00 4.59E-01			1.57E+01 4.70E+00			2.29E+01 6.88E+00			4.40E+00 1.32E+00					
CV or beta (Min Qty, Max Qty)	0.86 0.86			0.41 0.41			0.51 0.51			0.36 0.36					
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.4E+02	LogNormal	0.86	2.1E+03	Normal	0.41	3.6E+03	Normal	0.51	6.9E+02	LogNormal	0.36			
Embodied Energy (MJ)	6.0E+03	LogNormal	0.86	5.3E+04	Normal	0.41	9.0E+04	Normal	0.51	1.7E+04	LogNormal	0.36			
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			NO			NO			NO					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

None

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

D1014.022

Line 418

NISTIR Name

Hydraulic Elevator – Applies to most California Installations prior to 1976, most western states installations prior to 1982 and most U.S installations prior to 1998.

Description

Costing per elevator. Elevator demand parameter shall be defined as the peak floor acceleration at the first floor. The elevator fragility for a multiple story building should only be entered once on the first floor.

Construction Quality:

Any

Seismic Installation Conditions:

Any

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Peak Floor Acceleration g

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?	BLDG	
Demand Location (floor above?)	No	

Number of Damage States:

4

Damage State:

DS1

DS2

DS3

DS4

Type of Damage State:

Simultaneous

Simultaneous

Simultaneous

Simultaneous

DS Hierarchy

Simul(DS1,DS2,DS3,DS4)

Descriptions

Damaged controls.

Damaged vane and hoist-way switches, and or bent cab stabilizers, and or damaged car guide shoes.

Damaged entrance and car door, and or flooring damage.

Oil leak in hydraulic line, and or hydraulic tank failure.

Illustrations

none	none	none	none	
0.30	0.49	0.44	0.37	

Damage State Probability:

Fragility Parameters

Median Demand, θ :

0.3

0.3

0.3

0.3

Data dispersion, β_d :

0.28

Not Specified

Not Specified

Not Specified

Uncertainty, β_u :

0.1

Not Specified

Not Specified

Not Specified

Total Dispersion, β :

0.3

0.3

0.3

0.3

Correlation (Yes / No)

NO

Data Quality Not Rated

Documentation Quality Not Rated

Directionality (Yes / No)

NO

Data Relevance Not Rated

Rationality Not Rated

Consequence Functions

Repair Description

Multiple repairs possible (% change of each):
Repair damaged controls (100%)

Multiple repairs possible (% change of each):
Repair damaged vane and hoist-way switches (41%), and or repair bent cab stabilizers (41%), and or repair damaged car guide shoes (41%).

Multiple repairs possible (% change of each):
Repair damage to cab door (68%), and or repair cab flooring (46%)

Multiple repairs possible (% change of each):
Repair oil leak in hydraulic line (27%), and or hydraulic tank failure (81%)

Long Lead Time (Yes / No)

NO

NO

YES

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	4.00E+02	8.00E+02	2.50E+03	4.20E+03	8.20E+03	1.05E+04	4.00E+03	1.20E+04	1.60E+04	2.00E+03	2.30E+03	3.60E+03			
Best fit mean:	8.68E+02 LogNormal			7.63E+03 Normal			1.07E+04 Normal			2.54E+03 LogNormal					
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00			5.00 10.00			5.00 10.00					
Average Repair Cost (Min Qty, Max Qty)	1.60E+03 4.80E+02			1.64E+04 4.92E+03			2.40E+04 7.20E+03			4.60E+03 1.38E+03					
CV or beta (Min Qty, Max Qty)	0.82 0.82			0.32 0.32			0.44 0.44			0.25 0.25					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	4.00E-01	8.00E-01	2.50E+00	4.20E+00	8.20E+00	1.05E+01	4.00E+00	1.20E+01	1.60E+01	2.00E+00	2.30E+00	3.60E+00			
Best fit mean:	8.00E-01 LogNormal			8.20E+00 Normal			1.20E+01 Normal			2.30E+00 LogNormal					
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00			5.00 10.00			5.00 10.00					
Average Repair Time (Min Qty, Max Qty)	1.60E+00 4.80E-01			1.64E+01 4.92E+00			2.40E+01 7.20E+00			4.60E+00 1.38E+00					
CV or beta (Min Qty, Max Qty)	0.86 0.86			0.41 0.41			0.51 0.51			0.36 0.36					
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.4E+02	LogNormal	0.86	2.1E+03	Normal	0.41	3.6E+03	Normal	0.51	6.9E+02	LogNormal	0.36			
Embodied Energy (MJ)	6.0E+03	LogNormal	0.86	5.3E+04	Normal	0.41	9.0E+04	Normal	0.51	1.7E+04	LogNormal	0.36			
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			NO			NO			NO					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

None

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

D2021.011a

NISTIR Name
Description

Cold or Hot Potable - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC A or B, PIPING FRAGILITY
Potable water. Costing based upon 1000 ft segments.

Line 700

Construction Quality:	Normal				<div>Quantity RoundingRound Qty?NO Allow sum by floor or building?NO Demand Location (floor above)?Yes</div>
Seismic Installation Conditions:	SDC A or B				
Fragility Unit of Measure:	LF 1000				
Demand Parameter (unit):	Peak Floor Accelerationg				
Number of Damage States:	2				
Damage State:	DS1		DS2		
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Minor leakage at flange connections - 1 leak per 1000 feet of pipe. Pipe Break - 1 break per 1000 feet of pipe.				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	Yes	

Illustrations

none	none			
1.00	1.00			

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	1.5	2.6		
Data dispersion, β_d :	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified		
Total Dispersion, β :	0.4	0.4		
Correlation (Yes / No)	NO	Data Quality Not Rated	Documentation Quality Not Rated	
Directionality (Yes / No)	NO	Data Relevance Not Rated	Rationality Not Rated	

Consequence Functions
Repair Description

Retighten flange bolts at leaking joints. One joint per 1000 LF. Replace 20 foot sections of pipe where breaks occur. One repair per 1000 LF.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	9.00E+01	2.90E+02	7.40E+02	1.50E+03	2.65E+03	4.35E+03									
Best fit mean:	2.79E+02			2.60E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 4.00			1.00 4.00											
Average Repair Cost (Min Qty, Max Qty)	3.19E+02 2.61E+02			2.92E+03 2.39E+03											
CV or beta (Min Qty, Max Qty)	0.76 0.76			0.41 0.41											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.53E-02	3.07E-01	7.84E-01	1.59E-01	2.81E-01	4.61E-01									
Best fit mean:	3.07E-01			2.81E-01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 4.00			1.00 4.00											
Average Repair Time (Min Qty, Max Qty)	3.38E-01 2.76E-01			5.61E-01 1.40E-01											
CV or beta (Min Qty, Max Qty)	0.80 0.80			0.48 0.48											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	3.3E+01	LogNormal	0.80	4.8E+02	LogNormal	0.48									
Embodied Energy (MJ)	8.6E+02	LogNormal	0.80	1.2E+04	LogNormal	0.48									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										

Comments: Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D2021.011b

Cold or Hot Potable - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC A or B, BRACING FRAGILITY

Potable water. Costing based upon 1000 ft segments.

Line 701

Construction Quality:	Normal				<div>Quantity Rounding</div> <div>Round Qty?</div> <div>NO</div> <div>Allow sum by floor or building?</div> <div>NO</div> <div>Demand Location (floor above?)</div> <div>Yes</div>
Seismic Installation Conditions:	SDC A or B				
Fragility Unit of Measure:	LF 1000				
Demand Parameter (unit):	Peak Floor Accelerationg				
Number of Damage States:	2				
Damage State:	DS1		DS2		
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Lateral Brace Failure - 1 failure per 1000 feet of pipe. Vertical Brace Failure - 1 failure per 1000 feet of pipe.				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	Yes	

Illustrations

none	none			
1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	1.5	2.6			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO	Data Quality Not Rated		Documentation Quality Not Rated	
Directionality (Yes / No)	NO	Data Relevance Not Rated		Rationality Not Rated	

Consequence Functions

Repair Description

Retighten flange bolts at leaking joints. One joint per 1000 LF.

Replace 20 foot sections of pipe where breaks occur. One repair per 1000 LF.

Long Lead Time (Yes / No)NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.80E+02	3.80E+02	8.30E+02	3.60E+03	3.80E+03	4.25E+03									
Best fit mean:	3.83E+02			3.87E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 4.00			1.00 4.00											
Average Repair Cost (Min Qty, Max Qty)	4.18E+02 3.42E+02			4.18E+03 3.42E+03											
CV or beta (Min Qty, Max Qty)	0.60 0.60			0.07 0.07											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.91E-01	4.02E-01	8.79E-01	3.81E-01	4.02E-01	4.50E-01									
Best fit mean:	4.02E-01			4.02E-01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 4.00			1.00 4.00											
Average Repair Time (Min Qty, Max Qty)	4.43E-01 3.62E-01			8.05E-01 2.01E-01											
CV or beta (Min Qty, Max Qty)	0.65 0.65			0.26 0.26											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	3.3E+01	LogNormal	0.65	4.8E+02	LogNormal	0.26									
Embodied Energy (MJ)	8.6E+02	LogNormal	0.65	1.2E+04	LogNormal	0.26									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Not Given

By User

By User

Not Given

2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D2021.012b

Cold or Hot Potable - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC C, BRACING FRAGILITY

Potable water. Costing based upon 1000 ft segments.

Line 703

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

SDC C

LF 1000

Peak Floor Acceleration

2

DS1

Sequential

Seq(DS1,DS2)

Lateral Brace Failure - 1 failure per 1000 feet of pipe.

Vertical Brace Failure - 1 failure per 1000 feet of pipe.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

none

1.00

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.5

Not Specified

Not Specified

0.4

NO

NO

2.6

Not Specified

Not Specified

0.4

Data Quality Not Rated

Data Relevance Not Rated

Documentation Quality Not Rated

Rationality Not Rated

Consequence Functions

Repair Description

Retighten flange bolts at leaking joints. One joint per 1000 LF.

Replace 20 foot sections of pipe where breaks occur. One repair per 1000 LF..

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.80E+02

3.80E+02

8.30E+02

LogNormal

1.00

4.00

4.18E+02

3.42E+02

0.60

0.60

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

3.60E+03

3.80E+03

4.25E+03

LogNormal

1.00

4.00

4.18E+03

3.42E+03

0.07

0.07

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.91E-01

4.02E-01

8.79E-01

LogNormal

1.00

4.00

4.43E-01

3.62E-01

0.65

0.65

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

3.81E-01

4.02E-01

4.50E-01

LogNormal

1.00

4.00

8.05E-01

2.01E-01

0.26

0.26

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

3.6E+01

LogNormal

0.65

Median Cost

Best Fit

CV or Beta

3.6E+01

LogNormal

0.26

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Not Given

By User

By User

Not Given

2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

D2021.013a

NISTIR Name
Description

Cold or Hot Potable - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC D, E, or F, PIPING FRAGILITY
Potable water. Costing based upon 1000 ft segments.

Line 704

Construction Quality:	Normal					<div>Quantity RoundingRound Qty?NO</div> <div>Allow sum by floor or building?NO</div> <div>Demand Location (floor above?)Yes</div>
Seismic Installation Conditions:	SDC D, E or F (high seismic design)					
Fragility Unit of Measure:	LF 1000					
Demand Parameter (unit):	Peak Floor Accelerationg					
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Minor leakage at flange connections - 1 leak per 1000 feet of pipe. Pipe Break - 1 break per 1000 feet of pipe.					

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	Yes	

Illustrations

none	none			
1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	2.25	4.1			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO	Data Quality Not Rated		Documentation Quality Not Rated	
Directionality (Yes / No)	NO	Data Relevance Not Rated		Rationality Not Rated	

Consequence Functions
Repair Description

Replace failed lateral braces. One repair per 1000 LF.
Replace failed vertical braces. One repair per 1000 LF.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	9.00E+01	2.90E+02	7.40E+02	1.50E+03	2.65E+03	4.35E+03									
Best fit mean:	2.79E+02			2.60E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00											
Average Repair Cost (Min Qty, Max Qty)	3.19E+02 2.61E+02			2.92E+03 2.39E+03											
CV or beta (Min Qty, Max Qty)	0.76 0.76			0.41 0.41											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.53E-02	3.07E-01	7.84E-01	1.59E+00	2.81E+00	4.61E+00									
Best fit mean:	3.07E-01			2.81E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00											
Average Repair Time (Min Qty, Max Qty)	3.38E-01 2.76E-01			3.09E+00 2.53E+00											
CV or beta (Min Qty, Max Qty)	0.80 0.80			0.48 0.48											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	3.3E+01	LogNormal	0.80	4.8E+02	LogNormal	0.48									
Embodied Energy (MJ)	8.6E+02	LogNormal	0.80	1.2E+04	LogNormal	0.48									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments: Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

D2021.013b

NISTIR Name

Cold or Hot Potable - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC D, E, or F, BRACING FRAGILITY

Description

Potable water. Costing based upon 1000 ft segments.

Line 705

Construction Quality:

Normal

Seismic Installation Conditions:

SDC D, E or F (high seismic design)

Fragility Unit of Measure:

LF 1000

Demand Parameter (unit):

Peak Floor Acceleration g

Number of Damage States:

1

Damage State:

DS1

Type of Damage State:

Sequential

DS Hierarchy

Seq(DS1)

Descriptions

Lateral Brace Failure - 1 failure per 1000 feet of pipe.

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	Yes	Yes

Illustrations

none				
1.00				

Damage State Probability:

Fragility Parameters

Median Demand, θ :

1.5

Data dispersion, β_d :

Not Specified

Uncertainty, β_u :

Not Specified

Total Dispersion, β_t :

0.4

Correlation (Yes / No)

NO

Directionality (Yes / No)

NO

Data Quality Not Rated

Data Relevance Not Rated

Documentation Quality Not Rated

Rationality Not Rated

Consequence Functions

Repair Description

Retighten leaking joints. One joint per 1000 LF.
Replace 20 ft section of pipe at leaking joints.
One repair per 1000 LF.

Long Lead Time (Yes / No)

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.80E+02	3.80E+02	8.30E+02												
Best fit mean:	3.83E+02														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	3.00		10.00												
Average Repair Cost (Min Qty, Max Qty)	4.18E+02		3.42E+02												
CV or beta (Min Qty, Max Qty)	0.60		0.60												
Quantity Unit:	Each (1000 ft pipe)														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.91E-01	4.02E-01	8.79E-01												
Best fit mean:	4.02E-01														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	3.00		10.00												
Average Repair Time (Min Qty, Max Qty)	4.43E-01		3.62E-01												
CV or beta (Min Qty, Max Qty)	0.65		0.65												
Quantity Unit:	Each (1000 ft pipe)														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	3.6E+01	LogNormal	0.65												
Embodied Energy (MJ)	1.0E+03	LogNormal	0.65												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%		0.00												
Loss of Life (Median, Dispersion)	0%		0.00												
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00												

Comments:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D2021.014a

Cold or Hot Potable - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC D, E, or F (OSHPD or sim), PIPING FRAGILITY

Potable water. Costing based upon 1000 ft segments.

Line706

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Special Regulation (e.g. OSHPD) for piping installations

SDC D, E or F (high seismic design)

LF 1000

Peak Floor Accelerationg

2

DS1

Sequential

Seq(DS1,DS2)

Minor leakage at flange connections - 1 leak per 1000 feet of pipe.

Pipe Break - 1 break per 1000 feet of pipe.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.00

1.00

2.25

Not Specified

Not Specified

0.4

4.1

Not Specified

Not Specified

0.4

NO

NO

Data Quality

Not Rated

Data Relevance

Not Rated

Documentation Quality

Not Rated

Rationality

Not Rated

Consequence Functions

Repair Description

Replace failed supports. One repair per 1000 LF.

Replace failed supports. One repair per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P10P50P90

9.00E+012.90E+027.40E+02

2.79E+02

LogNormal

3.0010.00

3.19E+022.61E+02

0.760.76

Each (1000 ft pipe)

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P10P50P90

9.53E-023.07E-017.84E-01

3.07E-01

LogNormal

3.0010.00

3.38E-012.76E-01

0.800.80

Each (1000 ft pipe)

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median CostBest FitCV or Beta

3.3E+01LogNormal0.80

4.8E+02LogNormal0.48

8.6E+02LogNormal0.80

1.2E+04LogNormal0.48

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

NO

Not Applicable

Not Applicable

0%0.00

0%0.00

NO

0%0.00

0%0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Not Given

By User

By User

Not Given

2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

D2021.022a

NISTIR Name
Description

Cold or Hot Potable Water Piping (dia > 2.5 inches), SDC C, PIPING FRAGILITY
Potable water. Costing based upon 1000 ft segments.

Line 709

Construction Quality:	Normal				<div>Quantity RoundingRound Qty?NO</div> <div>Allow sum by floor or building?NO</div> <div>Demand Location (floor above?)Yes</div>
Seismic Installation Conditions:	SDC C				
Fragility Unit of Measure:	LF 1000				
Demand Parameter (unit):	Peak Floor Accelerationg				
Number of Damage States:	2				
Damage State:	DS1		DS2		
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Minor leakage at flange connections - 1 leak per 1000 feet of pipe. Pipe Break - 1 break per 1000 feet of pipe.				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	Yes	

Illustrations

none	none			
1.00	1.00			

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	1.5	2.6		
Data dispersion, β_d :	0.4	0.40		
Uncertainty, β_u :	Not Specified	Not Specified		
Total Dispersion, β :	0.4	0.4		
Correlation (Yes / No)	NO	Data Quality Not Rated	Documentation Quality Not Rated	
Directionality (Yes / No)	NO	Data Relevance Not Rated	Rationality Not Rated	

Consequence Functions

Repair Description	Retighten leaking joints. One joint per 1000 LF.	Replace 20 ft section of pipe at leaking joints. One repair per 1000 LF.
--------------------	--	--

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.50E+02	3.50E+02	8.00E+02	1.80E+03	3.35E+03	5.35E+03									
Best fit mean:	3.48E+02			3.21E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Cost (Min Qty, Max Qty)	7.00E+02 2.10E+02			6.70E+03 2.01E+03											
CV or beta (Min Qty, Max Qty)	0.65 0.65			0.40 0.40											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.59E-01	3.71E-01	8.47E-01	1.91E+00	3.55E+00	5.66E+00									
Best fit mean:	3.71E-01			3.55E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Time (Min Qty, Max Qty)	7.41E-01 2.22E-01			7.09E+00 2.13E+00											
CV or beta (Min Qty, Max Qty)	0.70 0.70			0.47 0.47											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.3E+01	LogNormal	0.70	3.6E+02	LogNormal	0.47									
Embodied Energy (MJ)	5.7E+02	LogNormal	0.70	9.2E+03	LogNormal	0.47									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments:	Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.		Root Cost Multiplier:	1
Date Created:	Not Given		Date Generated:	02/26/19
Approved (YES / NO)?	By User			
Official (YES / NO) ?	By User			
Author:	Not Given			
Revisions:	2016-10-26 - Corrected consequence descriptions.			

FEMA P-58 Fragility Specification

NISTIR Classification

D2021.023a

NISTIR Name

Cold or Hot Potable Water Piping (dia > 2.5 inches), SDC D,E,F, PIPING FRAGILITY

Description

Potable water. Costing based upon 1000 ft segments.

Line 710

Construction Quality:

Normal

Seismic Installation Conditions:

SDC D, E or F (high seismic design)

Fragility Unit of Measure:

LF 1000

Demand Parameter (unit):

Peak Floor Acceleration g

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Minor leakage at flange connections - Pipe Break - 1 break per 1000 feet of pipe.
1 leak per 1000 feet of pipe.

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	Yes	

Illustrations

none	none			
1.00	1.00			

Damage State Probability:

Fragility Parameters

Median Demand, θ :

2.25

4.1

Data dispersion, β_d :

0.4

0.40

Uncertainty, β_u :

Not Specified

Not Specified

Total Dispersion, β :

0.4

0.4

Correlation (Yes / No)

NO

Data Quality Not Rated

Documentation Quality Not Rated

Directionality (Yes / No)

NO

Data Relevance Not Rated

Rationality Not Rated

Consequence Functions

Repair Description

Replace failed supports. One repair per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.50E+02	3.50E+02	8.00E+02	1.80E+03	3.35E+03	5.35E+03									
Best fit mean:	3.48E+02			3.21E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Cost (Min Qty, Max Qty)	7.00E+02 2.10E+02			6.70E+03 2.01E+03											
CV or beta (Min Qty, Max Qty)	0.65 0.65			0.40 0.40											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.59E-01	3.71E-01	8.47E-01	1.91E+00	3.55E+00	5.66E+00									
Best fit mean:	3.71E-01			3.55E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Time (Min Qty, Max Qty)	7.41E-01 2.22E-01			7.09E+00 2.13E+00											
CV or beta (Min Qty, Max Qty)	0.70 0.70			0.47 0.47											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.3E+01	LogNormal	0.70	3.6E+02	LogNormal	0.47									
Embodied Energy (MJ)	5.7E+02	LogNormal	0.70	9.2E+03	LogNormal	0.47									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										

Comments:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Date Created:

Not Given

Root Cost Multiplier: 1

Approved (YES / NO)?

By User

Date Generated: 02/26/19

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2016-10-26 - Corrected consequence descriptions.

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D2021.023b

Cold or Hot Potable Water Piping (dia > 2.5 inches), SDC D,E,F, BRACING FRAGILITY

Potable water. Costing based upon 1000 ft segments.

Line 711

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

SDC D, E or F (high seismic design)

LF 1000

Peak Floor Acceleration

2

DS1

Sequential

Seq(DS1,DS2)

Lateral Brace Failure - 1 failure per 1000 feet of pipe.

Vertical Brace Failure - 1 failure per 1000 feet of pipe.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

none

none

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.00

1.5

0.4

Not Specified

0.4

NO

NO

2.25

0.40

Not Specified

0.4

Data Quality Not Rated

Data Relevance Not Rated

Documentation Quality Not Rated

Rationality Not Rated

Consequence Functions

Repair Description

Retighten leaking joints. One joint per 1000 LF.

Replace 20 ft section of pipe at leaking joints. One repair per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Time:

Environmental Impacts:

LifeSafety Hazard:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.50E+02

3.50E+02

8.00E+02

LogNormal

5.00

10.00

7.00E+02

2.10E+02

0.65

0.65

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

1.50E+02

3.50E+02

8.00E+02

LogNormal

5.00

10.00

7.00E+02

2.10E+02

0.65

0.65

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.59E-01

3.71E-01

8.47E-01

LogNormal

5.00

10.00

7.41E-01

2.22E-01

0.70

0.70

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

1.59E-01

3.71E-01

8.47E-01

LogNormal

5.00

10.00

7.41E-01

2.22E-01

0.70

0.70

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

4.0E+01

LogNormal

0.70

Median Cost

Best Fit

CV or Beta

0.0E+00

LogNormal

0.70

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Not Given

By User

By User

Not Given

2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D2021.024a

Cold or Hot Potable Water Piping (dia > 2.5 inches), SDC D,E,F (OSPHD or sim), PIPING FRAGILITY

Potable water. Costing based upon 1000 ft segments.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Special Regulation (e.g. OSHPD) for piping installations

SDC D, E or F (high seismic design)

LF 1000

Peak Floor Acceleration

2

DS1

Sequential

Seq(DS1,DS2)

Minor leakage at flange connections - 1 leak per 1000 feet of pipe.

Pipe Break - 1 break per 1000 feet of pipe.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

none

1.00

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

2.25

0.4

Not Specified

0.4

NO

NO

Data Quality

Data Relevance

Not Rated

Not Rated

Documentation Quality

Rationality

Not Rated

Not Rated

Consequence Functions

Repair Description

Replace failed supports. One repair per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.50E+02

3.50E+02

8.00E+02

3.48E+02

LogNormal

5.00

10.00

7.00E+02

2.10E+02

0.65

0.65

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

1.80E+03

3.35E+03

5.35E+03

3.21E+03

LogNormal

5.00

10.00

6.70E+03

2.01E+03

0.40

0.40

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.59E-01

3.71E-01

8.47E-01

3.71E-01

LogNormal

5.00

10.00

7.41E-01

2.22E-01

0.70

0.70

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

1.91E+00

3.55E+00

5.66E+00

3.55E+00

LogNormal

5.00

10.00

7.09E+00

2.13E+00

0.47

0.47

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

2.3E+01

LogNormal

0.70

3.6E+02

LogNormal

0.47

Median Cost

Best Fit

CV or Beta

3.6E+02

LogNormal

0.47

9.2E+03

LogNormal

0.47

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Not Given

By User

By User

Not Given

2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D2021.024b

Cold or Hot Potable Water Piping (dia > 2.5 inches), SDC D,E,F (OSPHD or sim), BRACING FRAGILITY

Potable water. Costing based upon 1000 ft segments.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Special Regulation (e.g. OSPHD) for piping installations

SDC D, E or F (high seismic design)

LF 1000

Peak Floor Acceleration

2

DS1

Sequential

Seq(DS1,DS2)

Lateral Brace Failure - 1 failure per 1000 feet of pipe.

Vertical Brace Failure - 1 failure per 1000 feet of pipe.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

none

none

Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

1.5

0.4

Not Specified

0.4

2.25

0.40

Not Specified

0.4

Correlation (Yes / No)

NO

Data Quality

Not Rated

Documentation Quality

Not Rated

Directionality (Yes / No)

NO

Data Relevance

Not Rated

Rationality

Not Rated

Consequence Functions

Repair Description

Retighten flange bolts at leaking joints. One joint per 1000 LF.

Replace 20 foot sections of pipe where breaks occur. One repair per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.50E+02

3.50E+02

8.00E+02

LogNormal

5.00

10.00

7.00E+02

2.10E+02

0.65

0.65

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

1.50E+02

3.50E+02

8.00E+02

LogNormal

5.00

10.00

7.00E+02

2.10E+02

0.65

0.65

Each (1000 ft pipe)

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.59E-01

3.71E-01

8.47E-01

LogNormal

5.00

10.00

7.41E-01

2.22E-01

0.70

0.70

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

1.59E-01

3.71E-01

8.47E-01

LogNormal

5.00

10.00

7.41E-01

2.22E-01

0.70

0.70

Each (1000 ft pipe)

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

4.0E+01

LogNormal

0.70

Median Cost

Best Fit

CV or Beta

0.0E+00

LogNormal

0.70

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Not Given

By User

By User

Not Given

2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

D2022.011a

NISTIR Name
Description

Heating hot Water Piping - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC A or B, PIPING FRAGILITY
Heating water. Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Line 714

Construction Quality:	Normal					<div>Quantity Rounding</div> <div>Round Qty?</div> <div>NO</div> <div>Allow sum by floor or building?</div> <div>NO</div> <div>Demand Location (floor above?)</div> <div>Yes</div>
Seismic Installation Conditions:	SDC A or B (no seismic design)					
Fragility Unit of Measure:	LF 1000					
Demand Parameter (unit):	Peak Floor Accelerationg					
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Small Leakage at joints - 1 leak per 1000 feet of pipe. Large Leakage w/ major repair - 1 leak per 1000 feet of pipe.					

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	Yes	Yes

Illustrations

none	none			
1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.55	1.1			
Data dispersion, β_d :	0.4	0.40			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	By User	By User			
Correlation (Yes / No)	NO	Data Quality Not Rated		Documentation Quality Not Rated	
Directionality (Yes / No)	NO	Data Relevance Not Rated		Rationality Not Rated	

Consequence Functions
Repair Description

Retighten flange bolts at leaking joints. One repair per 1000 LF. Replace 20 foot sections of pipe where breaks occur. One repair per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	9.00E+01	2.90E+02	7.40E+02	1.50E+03	2.65E+03	4.35E+03									
Best fit mean:	2.79E+02			2.60E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 4.00			1.00 4.00											
Average Repair Cost (Min Qty, Max Qty)	3.19E+02 2.61E+02			2.92E+03 2.39E+03											
CV or beta (Min Qty, Max Qty)	0.76 0.76			0.41 0.41											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.53E-02	3.07E-01	7.84E-01	1.59E-01	2.81E-01	4.61E-01									
Best fit mean:	3.07E-01			2.81E-01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 4.00			1.00 4.00											
Average Repair Time (Min Qty, Max Qty)	3.38E-01 2.76E-01			5.61E-01 1.40E-01											
CV or beta (Min Qty, Max Qty)	0.80 0.80			0.48 0.48											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.3E+01	LogNormal	0.80	3.6E+02	LogNormal	0.48									
Embodied Energy (MJ)	5.7E+02	LogNormal	0.80	9.2E+03	LogNormal	0.48									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										

Comments: Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.
Date Created: None
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

D2022.011b

NISTIR Name

Heating hot Water Piping - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC A or B, BRACING FRAGILITY

Description

Heating water. Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Line 715

Construction Quality:

Normal

Seismic Installation Conditions:

SDC A or B (no seismic design)

Fragility Unit of Measure:

LF 1000

Demand Parameter (unit):

Peak Floor Acceleration g

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Isolated support failure w/o leakage - 0.5 supports fail per 1000 feet of pipe (assuming supports every 20 feet).

Multiple supports failure and 60 feet of pipe fail per 1000 feet of pipe (assuming supports every 20 feet).

Illustrations

none	none			
1.00	1.00			

Damage State Probability:

Fragility Parameters

Median Demand, θ :

1.2

2.4

Data dispersion, β_d :

0.5

0.50

Uncertainty, β_u :

Not Specified

Not Specified

Total Dispersion, β :

By User

By User

Correlation (Yes / No)

NO

Data Quality Not Rated

Documentation Quality Not Rated

Directionality (Yes / No)

NO

Data Relevance Not Rated

Rationality Not Rated

Consequence Functions

Repair Description

Retighten flange bolts at leaking joints. One repair per 1000 LF.

Replace 20 foot sections of pipe where breaks occur. One repair per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.80E+02	3.80E+02	8.30E+02	3.60E+03	3.80E+03	4.25E+03									
Best fit mean:	3.83E+02			3.87E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 4.00			1.00 4.00											
Average Repair Cost (Min Qty, Max Qty)	4.18E+02 3.42E+02			4.18E+03 3.42E+03											
CV or beta (Min Qty, Max Qty)	0.60 0.60			0.07 0.07											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.91E-01	4.02E-01	8.79E-01	3.81E-01	4.02E-01	4.50E-01									
Best fit mean:	4.02E-01			4.02E-01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 4.00			1.00 4.00											
Average Repair Time (Min Qty, Max Qty)	4.43E-01 3.62E-01			8.05E-01 2.01E-01											
CV or beta (Min Qty, Max Qty)	0.65 0.65			0.26 0.26											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.0E+01	LogNormal	0.65	6.3E+02	LogNormal	0.26									
Embodied Energy (MJ)	1.1E+03	LogNormal	0.65	1.7E+04	LogNormal	0.26									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Date Created:

None

Root Cost Multiplier: 1

Approved (YES / NO)?

By User

Date Generated: 02/26/19

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2016-10-26 - Corrected consequence descriptions.

FEMA P-58 Fragility Specification

NISTIR Classification

D2022.012a

Line 716

NISTIR Name
Description

Heating hot Water Piping - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC C, PIPING FRAGILITY
Heating water. Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Construction Quality:

Normal

Seismic Installation Conditions:

SDC C (low seismic design)

Fragility Unit of Measure:

LF 1000

Demand Parameter (unit):

Peak Floor Acceleration g

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Small Leakage at joints - 1 leak per 1000 feet of pipe. Large Leakage w/ major repair - 1 leak per 1000 feet of pipe.

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	Yes	Yes

Illustrations

none	none			
1.00	1.00			

Damage State Probability:

Fragility Parameters

Median Demand, θ :

0.55

1.1

Data dispersion, β_d :

0.4

0.40

Uncertainty, β_u :

Not Specified

Not Specified

Total Dispersion, β :

By User

By User

Correlation (Yes / No)

NO

Data Quality Not Rated

Documentation Quality Not Rated

Directionality (Yes / No)

NO

Data Relevance Not Rated

Rationality Not Rated

Consequence Functions

Repair Description

Replace failed lateral braces. One repair per 1000 LF. Replace failed vertical braces. One repair per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	9.00E+01	2.90E+02	7.40E+02	1.50E+03	2.65E+03	4.35E+03									
Best fit mean:	2.79E+02			2.60E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 4.00			1.00 4.00											
Average Repair Cost (Min Qty, Max Qty)	3.19E+02 2.61E+02			2.92E+03 2.39E+03											
CV or beta (Min Qty, Max Qty)	0.76 0.76			0.41 0.41											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.53E-02	3.07E-01	7.84E-01	1.59E-01	2.81E-01	4.61E-01									
Best fit mean:	3.07E-01			2.81E-01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 4.00			1.00 4.00											
Average Repair Time (Min Qty, Max Qty)	3.38E-01 2.76E-01			5.61E-01 1.40E-01											
CV or beta (Min Qty, Max Qty)	0.80 0.80			0.48 0.48											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	2.3E+01	LogNormal	0.80	3.6E+02	LogNormal	0.48									
Embodied Energy (MJ)	5.7E+02	LogNormal	0.80	9.2E+03	LogNormal	0.48									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Date Created:

None

Root Cost Multiplier: 1

Approved (YES / NO)?

By User

Date Generated: 02/26/19

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2016-10-26 - Corrected consequence descriptions.

FEMA P-58 Fragility Specification

NISTIR Classification

D2022.012b

NISTIR Name
Description

Heating hot Water Piping - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC C, BRACING FRAGILITY
Heating water. Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Line 717

Construction Quality: Normal

Seismic Installation Conditions: SDC C (low seismic design)

Fragility Unit of Measure: LF 1000

Demand Parameter (unit): Peak Floor Acceleration g

Number of Damage States: 2

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy: Seq(DS1,DS2)

Descriptions: Isolated support failure w/o leakage - 0.5 supports fail per 1000 feet of pipe (assuming supports every 20 feet). Multiple supports failure and 60 feet of pipe fail per 1000 feet of pipe (assuming supports every 20 feet).

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

none	none			
1.00	1.00			

Fragility Parameters

Median Demand, θ : 1.2

Data dispersion, β_d : 0.5

Uncertainty, β_u : Not Specified By User

Total Dispersion, β : Not Specified By User

Correlation (Yes / No): NO

Directionality (Yes / No): NO

Data Quality: Not Rated

Data Relevance: Not Rated

Documentation Quality: Not Rated

Rationality: Not Rated

Consequence Functions

Repair Description: Retighten flange bolts at leaking joints. One repair per 1000 LF. Replace 20 foot sections of pipe where breaks occur. One repair per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.80E+02	3.80E+02	8.30E+02	3.60E+03	3.80E+03	4.25E+03									
Best fit mean:	3.83E+02			3.87E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 4.00			1.00 4.00											
Average Repair Cost (Min Qty, Max Qty)	4.18E+02 3.42E+02			4.18E+03 3.42E+03											
CV or beta (Min Qty, Max Qty)	0.60 0.60			0.07 0.07											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.91E-01	4.02E-01	8.79E-01	3.81E-01	4.02E-01	4.50E-01									
Best fit mean:	4.02E-01			4.02E-01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 4.00			1.00 4.00											
Average Repair Time (Min Qty, Max Qty)	4.43E-01 3.62E-01			8.05E-01 2.01E-01											
CV or beta (Min Qty, Max Qty)	0.65 0.65			0.26 0.26											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.0E+01	LogNormal	0.65	6.3E+02	LogNormal	0.26									
Embodied Energy (MJ)	1.1E+03	LogNormal	0.65	1.7E+04	LogNormal	0.26									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments: Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Date Created: None

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Not Given

Revisions: 2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

D2022.013a

NISTIR Name
Description

Heating hot Water Piping - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC D, E, or F, PIPING FRAGILITY
Heating water. Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Line 718

Construction Quality:

Normal

Seismic Installation Conditions:

SDC D, E, F (high seismic design)

Fragility Unit of Measure:

LF 1000

Demand Parameter (unit):

Peak Floor Acceleration g

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Small Leakage at joints - 1 leak per 1000 feet of pipe.
Large Leakage w/ major repair - 1 leak per 1000 feet of pipe.

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	Yes	Yes

Illustrations

none	none			
1.00	1.00			

Damage State Probability:

Fragility Parameters

Median Demand, θ :

0.55

1.1

Data dispersion, β_d :

0.4

0.40

Uncertainty, β_u :

Not Specified

Not Specified

Total Dispersion, β :

By User

By User

Correlation (Yes / No)

NO

Data Quality Not Rated

Documentation Quality Not Rated

Directionality (Yes / No)

NO

Data Relevance Not Rated

Rationality Not Rated

Consequence Functions

Repair Description

Replace failed lateral braces. One repair per 1000 LF.
Replace failed vertical braces. One repair per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	9.00E+01	2.90E+02	7.40E+02	1.50E+03	2.65E+03	4.35E+03									
Best fit mean:	2.79E+02			2.60E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00											
Average Repair Cost (Min Qty, Max Qty)	3.19E+02			2.92E+03											
CV or beta (Min Qty, Max Qty)	0.76			0.41											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.53E-02	3.07E-01	7.84E-01	1.59E+00	2.81E+00	4.61E+00									
Best fit mean:	3.07E-01			2.81E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00			3.00											
Average Repair Time (Min Qty, Max Qty)	3.38E-01			3.09E+00											
CV or beta (Min Qty, Max Qty)	0.80			0.48											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.3E+01	LogNormal	0.80	3.6E+02	LogNormal	0.48									
Embodied Energy (MJ)	5.7E+02	LogNormal	0.80	9.2E+03	LogNormal	0.48									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%			0%											
Loss of Life (Median, Dispersion)	0%			0%											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%			0%											

Comments:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Date Created:

None

Root Cost Multiplier: 1

Approved (YES / NO)?

By User

Date Generated: 02/26/19

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2016-10-26 - Corrected consequence descriptions.

FEMA P-58 Fragility Specification

NISTIR Classification

D2022.013b

Line 719

NISTIR Name
Description

Heating hot Water Piping - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC D, E, or F, BRACING FRAGILITY
Heating water. Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Construction Quality:

Normal

Seismic Installation Conditions:

SDC D, E, F (high seismic design)

Fragility Unit of Measure:

LF 1000

Demand Parameter (unit):

Peak Floor Acceleration g

Number of Damage States:

1

Damage State:

DS1

Type of Damage State:

Sequential

DS Hierarchy

Seq(DS1)

Descriptions

Isolated support failure w/o leakage -
0.5 supports fail per 1000 feet of pipe
(assuming supports every 20 feet).

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	Yes	Yes

Illustrations

none				
1.00				

Damage State Probability:

Fragility Parameters

Median Demand, θ :

2.25

Data dispersion, β_d :

0.4

Uncertainty, β_u :

Not Specified

Total Dispersion, β :

By User

Correlation (Yes / No)

NO

Directionality (Yes / No)

NO

Data Quality Not Rated

Data Relevance Not Rated

Documentation Quality Not Rated

Rationality Not Rated

Consequence Functions

Repair Description

Replace failed supports. One repair per 1000 LF.
Replace failed 60 ft pipe sections including supports. One repair per 1000 LF.

Long Lead Time (Yes / No)

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.80E+02	3.80E+02	8.30E+02												
Best fit mean:	3.83E+02														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	3.00		10.00												
Average Repair Cost (Min Qty, Max Qty)	4.18E+02		3.42E+02												
CV or beta (Min Qty, Max Qty)	0.60		0.60												
Quantity Unit:	Each (1000 ft pipe)														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.91E-01	4.02E-01	8.79E-01												
Best fit mean:	4.02E-01														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	3.00		10.00												
Average Repair Time (Min Qty, Max Qty)	4.43E-01		3.62E-01												
CV or beta (Min Qty, Max Qty)	0.65		0.65												
Quantity Unit:	Each (1000 ft pipe)														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	4.0E+01	LogNormal	0.65												
Embodied Energy (MJ)	1.1E+03	LogNormal	0.65												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%		0.00												
Loss of Life (Median, Dispersion)	0%		0.00												
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00												

Comments:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Date Created:

None

Approved (YES / NO)?

By User

Root Cost Multiplier: 1

Official (YES / NO) ?

By User

Date Generated: 02/26/19

Author:

Not Given

Revisions:

2016-10-26 - Corrected consequence descriptions.

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D2022.014a

Heating hot Water Piping - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC D, E, or F (OSHDP or sim), PIPING FRAGILITY

Heating water. Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Special Regulations (e.g. OSHPD) for Piping Installations

SDC D, E, F (high seismic design)

LF 1000

Peak Floor Acceleration

g

2

DS1

Sequential

DS2

Sequential

Seq(DS1,DS2)

Small Leakage at joints - 1 leak per 1000 feet of pipe.

Large Leakage w/ major repair - 1 leak per 1000 feet of pipe.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

none

none

Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

0.55

0.4

Not Specified

By User

1.1

0.40

Not Specified

By User

Correlation (Yes / No)

NO

Data Quality

Not Rated

Documentation Quality

Not Rated

Directionality (Yes / No)

NO

Data Relevance

Not Rated

Rationality

Not Rated

Consequence Functions

Repair Description

Replace failed supports. One repair per 1000 LF.

Replace failed 60 ft pipe sections including supports. One repair per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

9.00E+01

2.90E+02

7.40E+02

LogNormal

3.00

10.00

3.19E+02

2.61E+02

0.76

0.76

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

1.50E+03

2.65E+03

4.35E+03

LogNormal

3.00

10.00

2.92E+03

2.39E+03

0.41

0.41

Each (1000 ft pipe)

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

9.53E-02

3.07E-01

7.84E-01

LogNormal

3.00

10.00

3.38E-01

2.76E-01

0.80

0.80

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

1.59E+00

2.81E+00

4.61E+00

LogNormal

3.00

10.00

3.09E+00

2.53E+00

0.48

0.48

Each (1000 ft pipe)

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

2.3E+01

LogNormal

0.80

Median Cost

Best Fit

CV or Beta

3.6E+02

LogNormal

0.48

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

None

By User

By User

Not Given

2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

D2022.021a

NISTIR Name
Description

Heating hot Water Piping - Large Diameter Welded Steel - (greater than 2.5 inches in diameter), SDC A or B, PIPING FRAGILITY
Heating water. Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Line 722

Construction Quality:Normal

Seismic Installation Conditions:SDC A or B (no seismic design)

Fragility Unit of Measure:LF 1000

Demand Parameter (unit):Peak Floor Accelerationg

Number of Damage States:2

Damage State:DS1DS2

Type of Damage State:SequentialSequential

DS HierarchySeq(DS1,DS2)

DescriptionsMinor leakage at flange connections - 1 leak per 1000 feet of pipe. Pipe Break - 1 break per 1000 feet of pipe.

Quantity RoundingRound Qty?NO

Allow sum by floor or building?NO

Demand Location (floor above?)Yes

Illustrations

none

none

Damage State Probability:

1.001.00

Fragility Parameters

Median Demand, θ :1.5

Data dispersion, β_d :0.4

Uncertainty, β_u :Not Specified By User

Total Dispersion, β :Not Specified By User

Correlation (Yes / No)NO

Directionality (Yes / No)NO

Data Quality Not Rated

Data Relevance Not Rated

Documentation Quality Not Rated

Rationality Not Rated

Consequence Functions

Repair DescriptionReplace failed supports. One repair per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.50E+02	3.50E+02	8.00E+02	1.80E+03	3.35E+03	5.35E+03									
Best fit mean:	3.48E+02			3.21E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.0010.00			5.0010.00											
Average Repair Cost (Min Qty, Max Qty)	7.00E+022.10E+02			6.70E+032.01E+03											
CV or beta (Min Qty, Max Qty)	0.650.65			0.400.40											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.59E-01	3.71E-01	8.47E-01	1.91E+00	3.55E+00	5.66E+00									
Best fit mean:	3.71E-01			3.55E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.0010.00			5.0010.00											
Average Repair Time (Min Qty, Max Qty)	7.41E-012.22E-01			7.09E+002.13E+00											
CV or beta (Min Qty, Max Qty)	0.700.70			0.470.47											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	3.3E+01	LogNormal	0.70	4.8E+02	LogNormal	0.47									
Embodied Energy (MJ)	8.6E+02	LogNormal	0.70	1.2E+04	LogNormal	0.47									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%0.00			0%0.00											
Loss of Life (Median, Dispersion)	0%0.00			0%0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%0.00			0%0.00											

Comments:Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Date Created:None

Approved (YES / NO)?By User

Official (YES / NO) ?By User

Author:Not Given

Revisions:2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier:1

Date Generated:02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

D2022.022a

Line 723

NISTIR Name
Description

Heating hot Water Piping - Large Diameter Welded Steel - (greater than 2.5 inches in diameter), SDC C, PIPING FRAGILITY
Heating water. Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Construction Quality:Normal

Seismic Installation Conditions:SDC C (low seismic design)

Fragility Unit of Measure:LF 1000

Demand Parameter (unit):Peak Floor Accelerationg

Number of Damage States:2

Damage State:DS1DS2

Type of Damage State:SequentialSequential

DS HierarchySeq(DS1,DS2)

DescriptionsMinor leakage at flange connections - 1 leak per 1000 feet of pipe. Pipe Break - 1 break per 1000 feet of pipe.

Quantity RoundingRound Qty?NO

Allow sum by floor or building?NO

Demand Location (floor above?)Yes

Illustrations

none

none

Damage State Probability:

1.001.00

Fragility Parameters

Median Demand, θ :1.5

Data dispersion, β_d :0.4

Uncertainty, β_u :Not Specified By User

Total Dispersion, β :Not Specified By User

Correlation (Yes / No)NO

Directionality (Yes / No)NO

Data Quality Not Rated

Data Relevance Not Rated

Documentation Quality Not Rated

Rationality Not Rated

Consequence Functions

Repair DescriptionReplace failed supports. One repair per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.50E+02	3.50E+02	8.00E+02	1.80E+03	3.35E+03	5.35E+03									
Best fit mean:	3.48E+02			3.21E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.0010.00			5.0010.00											
Average Repair Cost (Min Qty, Max Qty)	7.00E+022.10E+02			6.70E+032.01E+03											
CV or beta (Min Qty, Max Qty)	0.650.65			0.400.40											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.59E-01	3.71E-01	8.47E-01	1.91E+00	3.55E+00	5.66E+00									
Best fit mean:	3.71E-01			3.55E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.0010.00			5.0010.00											
Average Repair Time (Min Qty, Max Qty)	7.41E-012.22E-01			7.09E+002.13E+00											
CV or beta (Min Qty, Max Qty)	0.700.70			0.470.47											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	3.3E+01	LogNormal	0.70	4.8E+02	LogNormal	0.47									
Embodied Energy (MJ)	8.6E+02	LogNormal	0.70	1.2E+04	LogNormal	0.47									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%0.00			0%0.00											
Loss of Life (Median, Dispersion)	0%0.00			0%0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%0.00			0%0.00											

Comments:Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Date Created:None

Approved (YES / NO)?By User

Official (YES / NO) ?By User

Author:Not Given

Revisions:2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier:1

Date Generated:02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

D2022.023a

NISTIR Name
Description

Heating hot Water Piping - Large Diameter Welded Steel - (greater than 2.5 inches in diameter), SDC D, E, or F, PIPING FRAGILITY
Heating water. Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Line 724

Construction Quality:	Normal			
Seismic Installation Conditions:	SDC D, E, F (high seismic design)			
Fragility Unit of Measure:	LF 1000			
Demand Parameter (unit):	Peak Floor Acceleration g			
Number of Damage States:	2			
Damage State:	DS1	DS2		
Type of Damage State:	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2)			
Descriptions	Minor leakage at flange connections - 1 leak per 1000 feet of pipe. Pipe Break - 1 break per 1000 feet of pipe.			

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	Yes	

Illustrations

none	none			
1.00	1.00			

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	2.25	4.1		
Data dispersion, β_d :	0.4	0.40		
Uncertainty, β_u :	Not Specified	Not Specified		
Total Dispersion, β :	By User	By User		
Correlation (Yes / No)	NO	Data Quality Not Rated	Documentation Quality Not Rated	
Directionality (Yes / No)	NO	Data Relevance Not Rated	Rationality Not Rated	

Consequence Functions
Repair Description

Replace failed supports. One repair per 1000 LF.
Replace failed 60 ft pipe sections including supports. One repair per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.50E+02	3.50E+02	8.00E+02	1.80E+03	3.35E+03	5.35E+03									
Best fit mean:	3.48E+02			3.21E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Cost (Min Qty, Max Qty)	7.00E+02 2.10E+02			6.70E+03 2.01E+03											
CV or beta (Min Qty, Max Qty)	0.65 0.65			0.40 0.40											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.59E-01	3.71E-01	8.47E-01	1.91E+00	3.55E+00	5.66E+00									
Best fit mean:	3.71E-01			3.55E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Time (Min Qty, Max Qty)	7.41E-01 2.22E-01			7.09E+00 2.13E+00											
CV or beta (Min Qty, Max Qty)	0.70 0.70			0.47 0.47											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	3.3E+01	LogNormal	0.70	4.8E+02	LogNormal	0.47									
Embodied Energy (MJ)	8.6E+02	LogNormal	0.70	1.2E+04	LogNormal	0.47									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										

Comments:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Date Created:
Approved (YES / NO)?
Official (YES / NO) ?
Author:
Revisions:

None
By User
By User
Not Given
2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier: 1
Date Generated: 02/26/19

2016_10_26_Corrected consequence descriptions

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D2022.024a

Heating hot Water Piping - Large Diameter Welded Steel - (greater than 2.5 inches in diameter), SDC D, E, or F (OSHDP or sim), PIPING FRAGILITY

Heating water. Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Special Regulation (e.g. OSHPD) for Piping Installations

SDC D, E, F (high seismic design)

LF 1000

Peak Floor Acceleration

g

2

DS1

Sequential

Seq(DS1,DS2)

Minor leakage at flange connections - 1 leak per 1000 feet of pipe.

DS2

Sequential

Not Specified

Pipe Break - 1 break per 1000 feet of pipe.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

none

none

Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

2.25

0.4

Not Specified

By User

4.1

0.40

Not Specified

By User

Correlation (Yes / No)

NO

Data Quality

Not Rated

Documentation Quality

Not Rated

Directionality (Yes / No)

NO

Data Relevance

Not Rated

Rationality

Not Rated

Consequence Functions

Repair Description

Replace failed supports. One repair per 1000 LF.

Replace failed 60 ft pipe sections including supports. One repair per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.50E+02

3.50E+02

8.00E+02

3.48E+02

LogNormal

5.00

10.00

7.00E+02

2.10E+02

0.65

0.65

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

1.80E+03

3.35E+03

5.35E+03

3.21E+03

LogNormal

5.00

10.00

6.70E+03

2.01E+03

0.40

0.40

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.59E-01

3.71E-01

8.47E-01

3.71E-01

LogNormal

5.00

10.00

7.41E-01

2.22E-01

0.70

0.70

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

1.91E+00

3.55E+00

5.66E+00

3.55E+00

LogNormal

5.00

10.00

7.09E+00

2.13E+00

0.47

0.47

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

3.3E+01

LogNormal

0.70

4.8E+02

LogNormal

0.47

Median Cost

Best Fit

CV or Beta

8.6E+02

LogNormal

0.70

1.2E+04

LogNormal

0.47

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

None

By User

By User

Not Given

2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier:

1

Date Generated:

02/26/19

Line 727

Heating hot Water Piping - Large Diameter Welded Steel - (greater than 2.5 inches in diameter), SDC D, E, or F (OSHPD or sim), BRACING FRAGILITY Heating water. Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Number of Damage States:	2	
Damage State:	DS1	DS2
Type of Damage State:	Sequential	Sequential
DS Hierarchy	Seq(DS1,DS2)	
Descriptions	Lateral Brace Failure - 1 failure per 1000 foot of pipe.	Vertical Brace Failure - 1 failure per 1000 feet of pipe.

Illustrations

none	none			
1.00	1.00			
1.5	2.25			
0.4	0.40			
Not Specified By User	Not Specified By User			
NO	Data Quality	Not Rated	Documentation Quality	Not Rated
NO	Data Relevance	Not Rated	Rationality	Not Rated

Replace failed supports. One repair per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀			
Repair Cost by Damage State:	1.50E+02	3.50E+02	8.00E+02	1.50E+02	3.50E+02	8.00E+02												
Best fit mean:	3.48E+02			3.48E+02														
Best Fit Distribution:	LogNormal			LogNormal														
Quantity Plateau (Min Qty, Max Qty)	5.00		10.00	5.00		10.00												
Average Repair Cost (Min Qty, Max Qty)	7.00E+02		2.10E+02	7.00E+02		2.10E+02												
CV or beta (Min Qty, Max Qty)	0.65		0.65	0.65		0.65												
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀			
Repair Time by Damage State:	1.59E-01	3.71E-01	8.47E-01	1.59E-01	3.71E-01	8.47E-01												
Best fit mean:	3.71E-01			3.71E-01														
Best Fit Distribution:	LogNormal			LogNormal														
Quantity Plateau (Min Qty, Max Qty)	5.00		10.00	5.00		10.00												
Average Repair Time (Min Qty, Max Qty)	7.41E-01		2.22E-01	7.41E-01		2.22E-01												
CV or beta (Min Qty, Max Qty)	0.70		0.70	0.70		0.70												
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta			
Embodied Carbon (kg CO2eq)	3.6E+01	LogNormal	0.70	3.6E+01	LogNormal	0.70												
Embodied Energy (MJ)	1.0E+03	LogNormal	0.70	1.0E+03	LogNormal	0.70												
LifeSafety Hazard:																		
Potential non-collapse casualties? (Yes / No)	NO			NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00													
Post-event Tagging Flag:	NO			NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00													

Comments:	Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.	
Date Created:	None	Root Cost Multiplier: 1
Approved (YES / NO)?	By User	Date Generated: 02/26/19
Official (YES / NO) ?	By User	
Author:	Not Given	
Revisions:	2016-10-26 - Corrected consequence descriptions.	

FEMA P-58 Fragility Specification

NISTIR Classification D2031.011b
NISTIR Name Sanitary Waste Piping - Cast Iron w/flexible couplings, SDC A,B, BRACING FRAGILITY
Description Costing based upon 1000 ft segments of pipe

Line 728

Construction Quality: Normal

Seismic Installation Conditions: SDC A or B

Quantity Rounding Round Qty? NO

Fragility Unit of Measure: LF 1000

Allow sum by floor or building? NO

Demand Parameter (unit): Peak Floor Acceleration g

Demand Location (floor above?) Yes

Number of Damage States: 2

Damage State: DS1 Sequential

DS2 Sequential

Type of Damage State: Seq(DS1,DS2)

DS Hierarchy

Descriptions

Isolated support failure w/o leakage - 60 feet of pipe fail per 1000 feet of pipe (assuming supports every 20 feet).

Multiple supports failure and 60 feet of pipe fail per 1000 feet of pipe (assuming supports every 20 feet).

Illustrations

none

none

Damage State Probability: 1.00

1.00

Fragility Parameters

Median Demand, θ : 1.2

2.4

Data dispersion, β_d : 0.5

0.50

Uncertainty, β_u : Not Specified By User

Not Specified By User

Total Dispersion, β :

Correlation (Yes / No) NO

Data Quality Not Rated

Documentation Quality Not Rated

Directionality (Yes / No) NO

Data Relevance Not Rated

Rationality Not Rated

Consequence Functions

Repair Description

Replace failed supports - 0.5 per 1000 LF.

Replace failed supports and 60 ft pipe per 1000 LF.

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.00E+02	4.00E+02	8.50E+02	1.80E+03	2.85E+03	4.35E+03									
Best fit mean:	4.06E+02			2.82E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Cost (Min Qty, Max Qty)	8.00E+02 2.40E+02			5.70E+03 1.71E+03											
CV or beta (Min Qty, Max Qty)	0.58 0.58			0.34 0.34											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.12E-01	4.24E-01	9.00E-01	1.91E+00	3.02E+00	4.61E+00									
Best fit mean:	4.24E-01			3.02E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Time (Min Qty, Max Qty)	8.47E-01 2.54E-01			6.04E+00 1.81E+00											
CV or beta (Min Qty, Max Qty)	0.63 0.63			0.42 0.42											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.6E+01	LogNormal	0.63	4.0E+02	LogNormal	0.42									
Embodied Energy (MJ)	1.3E+03	LogNormal	0.63	1.0E+04	LogNormal	0.42									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments: Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Date Created: None Root Cost Multiplier: 1

Approved (YES / NO)? By User Date Generated: 02/26/19

Official (YES / NO) ? By User

Author: Not Given

Revisions: 2016-10-26 - Corrected consequence descriptions.

FEMA P-58 Fragility Specification

NISTIR Classification

D2031.012b

NISTIR Name

Sanitary Waste Piping - Cast Iron w/flexible couplings, SDC C, BRACING FRAGILITY

Description

Costing based upon 1000 ft segments of pipe

Line 729

Construction Quality:

Normal

Seismic Installation Conditions:

SDC C

Fragility Unit of Measure:

LF 1000

Demand Parameter (unit):

Peak Floor Acceleration g

Quantity Rounding Round Qty? NO

Allow sum by floor or building? NO

Demand Location (floor above?) Yes

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Isolated support failure w/o leakage - 60 feet of pipe fail per 1000 feet of pipe (assuming supports every 20 feet).
Multiple supports failure and 60 feet of pipe fail per 1000 feet of pipe (assuming supports every 20 feet).

Illustrations

none	none			
1.00	1.00			

Damage State Probability:

Fragility Parameters

Median Demand, θ :

1.2

2.4

Data dispersion, β_d :

0.5

0.50

Uncertainty, β_u :

Not Specified

Not Specified

Total Dispersion, β :

By User

By User

Correlation (Yes / No)

NO

Data Quality Not Rated

Documentation Quality Not Rated

Directionality (Yes / No)

NO

Data Relevance Not Rated

Rationality Not Rated

Consequence Functions

Repair Description

Replace failed supports - 0.5 per 1000 LF.
Replace failed supports and 60 ft pipe per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.00E+02	4.00E+02	8.50E+02	1.80E+03	2.85E+03	4.35E+03									
Best fit mean:	4.06E+02			2.82E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Cost (Min Qty, Max Qty)	8.00E+02 2.40E+02			5.70E+03 1.71E+03											
CV or beta (Min Qty, Max Qty)	0.58 0.58			0.34 0.34											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.12E-01	4.24E-01	9.00E-01	1.91E+00	3.02E+00	4.61E+00									
Best fit mean:	4.24E-01			3.02E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Time (Min Qty, Max Qty)	8.47E-01 2.54E-01			6.04E+00 1.81E+00											
CV or beta (Min Qty, Max Qty)	0.63 0.63			0.42 0.42											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	4.6E+01	LogNormal	0.63	4.0E+02	LogNormal	0.42									
Embodied Energy (MJ)	1.3E+03	LogNormal	0.63	1.0E+04	LogNormal	0.42									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Date Created:

None

Root Cost Multiplier: 1

Approved (YES / NO)?

By User

Date Generated: 02/26/19

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2016-10-26 - Corrected consequence descriptions.

FEMA P-58 Fragility Specification

NISTIR Classification

D2031.013b

NISTIR Name
Description

Sanitary Waste Piping - Cast Iron w/flexible couplings, SDC D,E,F, BRACING FRAGILITY
Costing based upon 1000 ft segments of pipe

Line 730

Construction Quality:	Normal			
Seismic Installation Conditions:	SDC D, E or F (high seismic design)			
Fragility Unit of Measure:	LF 1000			
Demand Parameter (unit):	Peak Floor Acceleration g			
Number of Damage States:	1			
Damage State:	DS1			
Type of Damage State:	Sequential			
DS Hierarchy	Seq(DS1)			
Descriptions	Isolated support failure w/o leakage - 0.5 supports fail per 1000 feet of pipe (assuming supports every 20 feet).			

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations

none				
1.00				

Damage State Probability:	1.00			
Fragility Parameters				
Median Demand, θ :	2.25			
Data dispersion, β_d :	0.4			
Uncertainty, β_u :	Not Specified			
Total Dispersion, β :	By User			
Correlation (Yes / No)	NO	Data Quality	Not Rated	Documentation Quality
Directionality (Yes / No)	NO	Data Relevance	Not Rated	Rationality

Consequence Functions
Repair Description

Replace failed supports - 0.5 per 1000 LF.

Long Lead Time (Yes / No)

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.00E+02	4.00E+02	8.50E+02												
Best fit mean:	4.06E+02														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	5.00		10.00												
Average Repair Cost (Min Qty, Max Qty)	8.00E+02		2.40E+02												
CV or beta (Min Qty, Max Qty)	0.58		0.58												
Quantity Unit:	Each (1000 ft pipe)														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.12E-01	4.24E-01	9.00E-01												
Best fit mean:	4.24E-01														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	5.00		10.00												
Average Repair Time (Min Qty, Max Qty)	8.47E-01		2.54E-01												
CV or beta (Min Qty, Max Qty)	0.63		0.63												
Quantity Unit:	Each (1000 ft pipe)														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.6E+01	LogNormal	0.63												
Embodied Energy (MJ)	1.3E+03	LogNormal	0.63												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%		0.00												
Loss of Life (Median, Dispersion)	0%		0.00												
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00												

Comments:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Date Created:
Approved (YES / NO)?
Official (YES / NO) ?
Author:
Revisions:

None
By User
By User
Not Given
2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D2031.014b

Sanitary Waste Piping - Cast Iron w/flexible couplings, SDC D,E,F (OSHPD or sim), BRACING FRAGILITY

Costing based upon 1000 ft segments of pipe

Line 731

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Special Regulation (e.g. OSHPD) for piping installations

SDC D, E or F (high seismic design)

LF 1000

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

Isolated support failure w/o leakage -

0.5 supports fail per 1000 feet of pipe

(assuming supports every 20 feet).

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

3

0.4

Not Specified

By User

NO

NO

Data Quality

Not Rated

Documentation Quality

Not Rated

Data Relevance

Not Rated

Rationality

Not Rated

Consequence Functions

Repair Description

Replace failed supports - 0.5 per 1000 LF.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau

(Min Qty, Max Qty)

Average Repair Cost

(Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

2.00E+02

4.00E+02

8.50E+02

4.06E+02

LogNormal

5.00

10.00

8.00E+02

2.40E+02

0.58

0.58

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau

(Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

2.12E-01

4.24E-01

9.00E-01

4.24E-01

LogNormal

5.00

10.00

8.47E-01

2.54E-01

0.63

0.63

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO₂eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

4.6E+01

LogNormal

0.63

1.3E+03

LogNormal

0.63

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

None

By User

By User

Not Given

2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D2031.021a

Sanitary Waste Piping - Cast Iron w/bell and spigot couplings, SDC A,B, PIPING FRAGILITY

Costing based upon 1000 ft segments of pipe

Line 732

Construction Quality:Normal

Seismic Installation Conditions:SDC A or B

Fragility Unit of Measure:LF 1000

Demand Parameter (unit):Peak Floor Accelerationg

Number of Damage States:1

Damage State:DS1

Type of Damage State:Sequential

DS Hierarchy:Seq(DS1)

Descriptions:Joints break - 1 break per 1000 feet of pipe.

Quantity RoundingRound Qty?NO

Allow sum by floor or building?NO

Demand Location (floor above?)Yes

Illustrations

none

1.00

Fragility Parameters

Median Demand, θ :2.25

Data dispersion, β_d :0.4

Uncertainty, β_u :Not Specified

Total Dispersion, β :By User

Correlation (Yes / No)NO

Directionality (Yes / No)NO

Data QualityNot Rated

Data RelevanceNot Rated

Documentation QualityNot Rated

RationalityNot Rated

Consequence Functions

Repair Description

Replace failed 20 ft pipe sections including supports - one per 1000 LF.

Long Lead Time (Yes / No)NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.80E+03	3.35E+03	4.35E+03												
Best fit mean:	3.17E+03														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	5.0010.00														
Average Repair Cost (Min Qty, Max Qty)	6.70E+032.01E+03														
CV or beta (Min Qty, Max Qty)	0.310.31														
Quantity Unit:	Each (1000 ft pipe)														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.91E+00	3.55E+00	4.61E+00												
Best fit mean:	3.55E+00														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	5.0010.00														
Average Repair Time (Min Qty, Max Qty)	7.09E+002.13E+00														
CV or beta (Min Qty, Max Qty)	0.400.40														
Quantity Unit:	Each (1000 ft pipe)														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.8E+02	Normal	0.40												
Embodied Energy (MJ)	1.2E+04	Normal	0.40												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%0.00														
Loss of Life (Median, Dispersion)	0%0.00														
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%0.00														

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

None

By User

By User

Not Given

2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification D2031.021b
NISTIR Name Sanitary Waste Piping - Cast Iron w/bell and spigot couplings, SDC A,B, BRACING FRAGILITY
Description Costing based upon 1000 ft segments of pipe

Line 733

Construction Quality: Normal

Seismic Installation Conditions: SDC A or B

Fragility Unit of Measure: LF 1000

Demand Parameter (unit): Peak Floor Acceleration g

Number of Damage States: 2

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy: Seq(DS1,DS2)

Descriptions: Isolated support failure w/o leakage - 0.5 supports fail per 1000 feet of pipe (assuming supports every 20 feet). Multiple supports failure and 60 feet of pipe fail per 1000 feet of pipe (assuming supports every 20 feet).

Quantity Rounding

Round Qty? NO

Allow sum by floor or building? NO

Demand Location (floor above?) Yes

DS1	DS2			
-----	-----	--	--	--

Illustrations

none	none			
1.00	1.00			

Damage State Probability:

Fragility Parameters				
Median Demand, θ :	1.2	2.4		
Data dispersion, β_d :	0.5	0.50		
Uncertainty, β_u :	Not Specified	Not Specified		
Total Dispersion, β :	By User	By User		
Correlation (Yes / No)	NO	Data Quality Not Rated	Documentation Quality Not Rated	
Directionality (Yes / No)	NO	Data Relevance Not Rated	Rationality Not Rated	

Consequence Functions

Repair Description

Replace failed supports - 0.5 per 1000 LF.

Replace failed supports and 60 ft pipe per 1000 LF.

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.00E+02	4.00E+02	1.05E+03	1.80E+03	4.35E+03	4.35E+03									
Best fit mean:	4.23E+02			3.50E+03											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Cost (Min Qty, Max Qty)	8.00E+02 2.40E+02			8.70E+03 2.61E+03											
CV or beta (Min Qty, Max Qty)	0.71 0.71			0.28 0.28											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.12E-01	4.24E-01	1.11E+00	1.91E+00	4.61E+00	4.61E+00									
Best fit mean:	4.24E-01			4.61E+00											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Time (Min Qty, Max Qty)	8.47E-01 2.54E-01			9.21E+00 2.76E+00											
CV or beta (Min Qty, Max Qty)	0.75 0.75			0.38 0.38											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.6E+01	LogNormal	0.75	6.6E+02	Normal	0.38									
Embodied Energy (MJ)	1.3E+03	LogNormal	0.75	1.7E+04	Normal	0.38									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments: Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Date Created: None

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Not Given

Revisions: 2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

D2031.022a

NISTIR Name
Description

Sanitary Waste Piping - Cast Iron w/bell and spigot couplings, SDC C, PIPING FRAGILITY
Costing based upon 1000 ft segments of pipe

Line 734

Construction Quality:	Normal				
Seismic Installation Conditions:	SDC C				
Fragility Unit of Measure:	LF 1000				
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	1				
Damage State:	DS1				
Type of Damage State:	Sequential				
DS Hierarchy	Seq(DS1)				
Descriptions	Isolated support failure w/o leakage - 0.5 supports fail per 1000 feet of pipe (assuming supports every 20 feet).				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	Yes	

Illustrations

none				
1.00				

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	1.2				
Data dispersion, β_d :	0.5				
Uncertainty, β_u :	Not Specified				
Total Dispersion, β :	By User				
Correlation (Yes / No)	NO	Data Quality	Not Rated	Documentation Quality	Not Rated
Directionality (Yes / No)	NO	Data Relevance	Not Rated	Rationality	Not Rated

Consequence Functions
Repair Description

Replace failed 20 ft pipe sections including supports - one per 1000 LF.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.80E+03	3.35E+03	4.35E+03												
Best fit mean:	3.17E+03														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	5.00		10.00												
Average Repair Cost (Min Qty, Max Qty)	6.70E+03		2.01E+03												
CV or beta (Min Qty, Max Qty)	0.31		0.31												
Quantity Unit:	Each (1000 ft pipe)														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.91E+00	3.55E+00	4.61E+00												
Best fit mean:	3.55E+00														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	5.00		10.00												
Average Repair Time (Min Qty, Max Qty)	7.09E+00		2.13E+00												
CV or beta (Min Qty, Max Qty)	0.40		0.40												
Quantity Unit:	Each (1000 ft pipe)														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.8E+02	Normal	0.40												
Embodied Energy (MJ)	1.2E+04	Normal	0.40												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments:	Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.	Root Cost Multiplier:	1
Date Created:	None	Date Generated:	02/26/19
Approved (YES / NO)?	By User		
Official (YES / NO) ?	By User		
Author:	Not Given		
Revisions:	2016-10-26 - Corrected consequence descriptions.		

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D2031.022b

Sanitary Waste Piping - Cast Iron w/bell and spigot couplings, SDC C, BRACING FRAGILITY

Costing based upon 1000 ft segments of pipe

Line 735

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

SDC C

LF 1000

Peak Floor Acceleration

2

DS1

Sequential

Seq(DS1,DS2)

Isolated support failure w/o leakage - 0.5 supports fail per 1000 feet of pipe (assuming supports every 20 feet).

DS2

Sequential

Multiple supports failure and 60 feet of pipe fail per 1000 feet of pipe (assuming supports every 20 feet)

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

none

none

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.00

1.00

1.2

0.5

Not Specified

By User

2.4

0.50

Not Specified

By User

NO

NO

Data Quality

Not Rated

Data Relevance

Not Rated

Documentation Quality

Not Rated

Rationality

Not Rated

Consequence Functions

Repair Description

Replace failed supports - 0.5 per 1000 LF.

Replace failed supports and 60 ft pipe per 1000 LF.

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.00E+02	4.00E+02	1.05E+03	1.80E+03	4.35E+03	4.35E+03									
Best fit mean:	4.23E+02			3.50E+03											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Cost (Min Qty, Max Qty)	8.00E+02 2.40E+02			8.70E+03 2.61E+03											
CV or beta (Min Qty, Max Qty)	0.71 0.71			0.28 0.28											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.12E-01	4.24E-01	1.11E+00	1.91E+00	4.61E+00	4.61E+00									
Best fit mean:	4.24E-01			4.61E+00											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Time (Min Qty, Max Qty)	8.47E-01 2.54E-01			9.21E+00 2.76E+00											
CV or beta (Min Qty, Max Qty)	0.75 0.75			0.38 0.38											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.6E+01	LogNormal	0.75	6.6E+02	Normal	0.38									
Embodied Energy (MJ)	1.3E+03	LogNormal	0.75	1.7E+04	Normal	0.38									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

None

By User

By User

Not Given

2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

D2031.023a

NISTIR Name
Description

Sanitary Waste Piping - Cast Iron w/bell and spigot couplings, SDC D,E,F, PIPING FRAGILITY
Costing based upon 1000 ft segments of pipe

Line 736

Construction Quality: Normal
Seismic Installation Conditions: SDC D, E or F (high seismic design)

Fragility Unit of Measure: LF 1000
Demand Parameter (unit): Peak Floor Acceleration g

Number of Damage States: 1
Damage State: DS1
Type of Damage State: Sequential
DS Hierarchy: Seq(DS1)
Descriptions: Joints break - 1 break per 1000 feet of pipe.

Quantity Rounding Round Qty? NO
Allow sum by floor or building? NO
Demand Location (floor above?) Yes

Illustrations

none				
1.00				

Damage State Probability:

Fragility Parameters					
Median Demand, θ :	3				
Data dispersion, β_d :	0.4				
Uncertainty, β_u :	Not Specified				
Total Dispersion, β :	By User				

Correlation (Yes / No) NO Data Quality Not Rated Documentation Quality Not Rated
Directionality (Yes / No) NO Data Relevance Not Rated Rationality Not Rated

Consequence Functions
Repair Description

Replace failed 20 ft pipe sections including supports - one per 1000 LF.

Long Lead Time (Yes / No)

NO

Repair Costs:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Cost by Damage State:	1.80E+03	3.35E+03	4.35E+03												
Best fit mean:	3.17E+03														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	5.00		10.00												
Average Repair Cost (Min Qty, Max Qty)	6.70E+03		2.01E+03												
CV or beta (Min Qty, Max Qty)	0.31		0.31												
Quantity Unit:	Each (1000 ft pipe)														
Repair Time:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Time by Damage State:	1.91E+00	3.55E+00	4.61E+00												
Best fit mean:	3.55E+00														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	5.00		10.00												
Average Repair Time (Min Qty, Max Qty)	7.09E+00		2.13E+00												
CV or beta (Min Qty, Max Qty)	0.40		0.40												
Quantity Unit:	Each (1000 ft pipe)														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.8E+02	Normal	0.40												
Embodied Energy (MJ)	1.2E+04	Normal	0.40												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments: Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.
Date Created: None
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D2031.023b

Sanitary Waste Piping - Cast Iron w/bell and spigot couplings, SDC D,E,F, BRACING FRAGILITY

Costing based upon 1000 ft segments of pipe

Line 737

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

SDC D, E or F (high seismic design)

LF 1000

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Isolated support failure w/o leakage -

0.5 supports fail per 1000 feet of pipe

(assuming supports every 20 feet).

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

2.25

0.4

Not Specified

By User

NO

NO

Data Quality

Not Rated

Documentation Quality

Not Rated

Data Relevance

Not Rated

Rationality

Not Rated

Consequence Functions

Repair Description

Replace failed supports - 0.5 per 1000 LF.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau

(Min Qty, Max Qty)

Average Repair Cost

(Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

2.00E+02

4.00E+02

1.05E+03

4.23E+02

LogNormal

5.00

10.00

8.00E+02

2.40E+02

0.71

0.71

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau

(Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

2.12E-01

4.24E-01

1.11E+00

4.24E-01

LogNormal

5.00

10.00

8.47E-01

2.54E-01

0.75

0.75

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO₂eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

4.6E+01

LogNormal

0.75

1.3E+03

LogNormal

0.75

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

None

By User

By User

Not Given

2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D2031.024a

Sanitary Waste Piping - Cast Iron w/bell and spigot couplings, SDC D,E,F (OSHPD or sim), PIPING FRAGILITY

Costing based upon 1000 ft segments of pipe

Line 738

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Special Regulation (e.g. OSHPD) for piping installations

SDC D, E or F (high seismic design)

LF 1000

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Joints break - 1 break per 1000 feet of pipe.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

3

0.4

Not Specified

By User

NO

NO

Data Quality

Not Rated

Documentation Quality

Not Rated

Data Relevance

Not Rated

Rationality

Not Rated

Consequence Functions

Repair Description

Replace failed 20 ft pipe sections including supports - one per 1000 LF.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.80E+03

3.35E+03

4.35E+03

3.17E+03

Normal

5.00

10.00

6.70E+03

2.01E+03

0.31

0.31

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.91E+00

3.55E+00

4.61E+00

3.55E+00

Normal

5.00

10.00

7.09E+00

2.13E+00

0.40

0.40

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO₂eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

4.8E+02

Normal

0.40

1.2E+04

Normal

0.40

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

None

By User

By User

Not Given

2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D2031.024b

Sanitary Waste Piping - Cast Iron w/bell and spigot couplings, SDC D,E,F (OSHDP or sim), BRACING FRAGILITY

Costing based upon 1000 ft segments of pipe

Line 739

Construction Quality:
Seismic Installation Conditions:
Fragility Unit of Measure:
Demand Parameter (unit):
Number of Damage States:
Damage State:
Type of Damage State:
DS Hierarchy
Descriptions

Special Regulation (e.g. OSHPD) for piping installations

SDC D, E or F (high seismic design)

LF 1000

Peak Floor Accelerationg

1

DS1

Sequential

Seq(DS1)

Isolated support failure w/o leakage -
0.5 supports fail per 1000 feet of pipe
(assuming supports every 20 feet).

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

none				
1.00				

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

2.25

0.4

Not Specified

By User

NO

NO

Data Quality

Not Rated

Documentation Quality

Not Rated

Data Relevance

Not Rated

Rationality

Not Rated

Consequence Functions

Repair Description

Retighten flange bolts at leaking joints.

Long Lead Time (Yes / No)

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.00E+02	4.00E+02	1.05E+03												
Best fit mean:	4.23E+02														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	5.0010.00														
Average Repair Cost (Min Qty, Max Qty)	8.00E+022.40E+02														
CV or beta (Min Qty, Max Qty)	0.710.71														
Quantity Unit:	Each (1000 ft pipe)														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.12E-01	4.24E-01	1.11E+00												
Best fit mean:	4.24E-01														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	5.0010.00														
Average Repair Time (Min Qty, Max Qty)	8.47E-012.54E-01														
CV or beta (Min Qty, Max Qty)	0.750.75														
Quantity Unit:	Each (1000 ft pipe)														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.6E+01	LogNormal	0.75												
Embodied Energy (MJ)	1.3E+03	LogNormal	0.75												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%0.00														
Loss of Life (Median, Dispersion)	0%0.00														
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%0.00														

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

None

By User

By User

Not Given

2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

D2051.011a

NISTIR Name

Chilled Water Piping - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC A or B, PIPING FRAGILITY

Description

Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Line 740

Construction Quality:

Normal

Seismic Installation Conditions:

SDC A or B (no seismic design)

Fragility Unit of Measure:

LF 1000

Demand Parameter (unit):

Peak Floor Acceleration g

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	Yes	Yes

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Small Leakage at joints - 1 leak per 1000 feet of pipe. Large Leakage w/ major repair - 1 leak per 1000 feet of pipe.

Illustrations

none	none			
1.00	1.00			

Damage State Probability:

Fragility Parameters

Median Demand, θ :

0.55

1.1

Data dispersion, β_d :

0.4

0.40

Uncertainty, β_u :

Not Specified

Not Specified

Total Dispersion, β :

By User

By User

Correlation (Yes / No)

NO

Data Quality Not Rated

Documentation Quality Not Rated

Directionality (Yes / No)

NO

Data Relevance Not Rated

Rationality Not Rated

Consequence Functions

Repair Description

Replace failed vertical braces. One repair per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	9.00E+01	2.90E+02	7.40E+02	1.50E+03	2.65E+03	4.35E+03									
Best fit mean:	2.79E+02			2.60E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Cost (Min Qty, Max Qty)	3.19E+02 2.61E+02			2.92E+03 2.39E+03											
CV or beta (Min Qty, Max Qty)	0.76 0.76			0.41 0.41											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.53E-02	3.07E-01	7.84E-01	1.59E-01	2.81E-01	4.61E-01									
Best fit mean:	3.07E-01			2.81E-01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Time (Min Qty, Max Qty)	3.38E-01 2.76E-01			5.61E-01 1.40E-01											
CV or beta (Min Qty, Max Qty)	0.80 0.80			0.48 0.48											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.3E+01	LogNormal	0.80	3.6E+02	LogNormal	0.48									
Embodied Energy (MJ)	5.7E+02	LogNormal	0.80	9.2E+03	LogNormal	0.48									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Date Created:

None

Root Cost Multiplier: 1

Approved (YES / NO)?

By User

Date Generated: 02/26/19

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2016-10-26 - Corrected consequence descriptions.

FEMA P-58 Fragility Specification

NISTIR Classification

D2051.011b

NISTIR Name

Chilled Water Piping - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC A or B, BRACING FRAGILITY

Description

Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Line 741

Construction Quality:

Normal

Seismic Installation Conditions:

SDC A or B (no seismic design)

Fragility Unit of Measure:

LF 1000

Demand Parameter (unit):

Peak Floor Acceleration g

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	Yes	Yes

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Isolated support failure w/o leakage - 0.5 supports fail per 1000 feet of pipe (assuming supports every 20 feet).

Multiple supports failure and 60 feet of pipe fail per 1000 feet of pipe (assuming supports every 20 feet).

Illustrations

none	none			
1.00	1.00			

Damage State Probability:

Fragility Parameters

Median Demand, θ :

1.2

2.4

Data dispersion, β_d :

0.5

0.50

Uncertainty, β_u :

Not Specified

Not Specified

Total Dispersion, β :

By User

By User

Correlation (Yes / No)

NO

Data Quality Not Rated

Documentation Quality Not Rated

Directionality (Yes / No)

NO

Data Relevance Not Rated

Rationality Not Rated

Consequence Functions

Repair Description

Retighten flange bolts at leaking joints. One repair per 1000 LF.

Replace 20 foot sections of pipe where breaks occur. One repair per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.80E+02	3.80E+02	8.30E+02	3.60E+03	3.80E+03	4.25E+03									
Best fit mean:	3.83E+02			3.87E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Cost (Min Qty, Max Qty)	4.18E+02 3.42E+02			4.18E+03 3.42E+03											
CV or beta (Min Qty, Max Qty)	0.60 0.60			0.07 0.07											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.91E-01	4.02E-01	8.79E-01	3.81E-01	4.02E-01	4.50E-01									
Best fit mean:	4.02E-01			4.02E-01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Time (Min Qty, Max Qty)	4.43E-01 3.62E-01			8.05E-01 2.01E-01											
CV or beta (Min Qty, Max Qty)	0.65 0.65			0.26 0.26											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	4.0E+01	LogNormal	0.65	6.3E+02	LogNormal	0.26									
Embodied Energy (MJ)	1.1E+03	LogNormal	0.65	1.7E+04	LogNormal	0.26									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Date Created:

None

Root Cost Multiplier: 1

Approved (YES / NO)?

By User

Date Generated: 02/26/19

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2016-10-26 - Corrected consequence descriptions.

FEMA P-58 Fragility Specification

NISTIR Classification

D2051.012a

NISTIR Name
Description

Chilled Water Piping - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC C, PIPING FRAGILITY
Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Line 742

Construction Quality:	Normal				<div>Quantity Rounding</div> <div>Round Qty?</div> <div>NO</div> <div>Allow sum by floor or building?</div> <div>NO</div> <div>Demand Location (floor above?)</div> <div>Yes</div>
Seismic Installation Conditions:	SDC C (low seismic design)				
Fragility Unit of Measure:	LF 1000				
Demand Parameter (unit):	Peak Floor Accelerationg				
Number of Damage States:	2				
Damage State:	DS1	DS2			
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Small Leakage at joints - 1 leak per 1000 feet of pipe. Large Leakage w/ major repair - 1 leak per 1000 feet of pipe.				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	Yes	

Illustrations

none	none			
1.00	1.00			

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	0.55	1.1		
Data dispersion, β_d :	0.4	0.40		
Uncertainty, β_u :	Not Specified	Not Specified		
Total Dispersion, β :	By User	By User		
Correlation (Yes / No)	NO	Data Quality Not Rated	Documentation Quality Not Rated	
Directionality (Yes / No)	NO	Data Relevance Not Rated	Rationality Not Rated	

Consequence Functions

Repair Description

Retighten flange bolts at leaking joints. One repair per 1000 LF. Replace 20 foot sections of pipe where breaks occur. One repair per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	9.00E+01	2.90E+02	7.40E+02	1.50E+03	2.65E+03	4.35E+03									
Best fit mean:	2.79E+02			2.60E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Cost (Min Qty, Max Qty)	3.19E+02 2.61E+02			2.92E+03 2.39E+03											
CV or beta (Min Qty, Max Qty)	0.76 0.76			0.41 0.41											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.53E-02	3.07E-01	7.84E-01	1.59E-01	2.81E-01	4.61E-01									
Best fit mean:	3.07E-01			2.81E-01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Time (Min Qty, Max Qty)	3.38E-01 2.76E-01			5.61E-01 1.40E-01											
CV or beta (Min Qty, Max Qty)	0.80 0.80			0.48 0.48											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.3E+01	LogNormal	0.80	3.6E+02	LogNormal	0.48									
Embodied Energy (MJ)	5.7E+02	LogNormal	0.80	9.2E+03	LogNormal	0.48									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Date Created:
Approved (YES / NO)?
Official (YES / NO) ?
Author:
Revisions:

None
By User
By User
Not Given
2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

D2051.012b

NISTIR Name

Chilled Water Piping - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC C, BRACING FRAGILITY

Description

Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Line 743

Construction Quality:

Normal

Seismic Installation Conditions:

SDC C (low seismic design)

Fragility Unit of Measure:

LF 1000

Demand Parameter (unit):

Peak Floor Acceleration g

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	Yes	Yes

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Isolated support failure w/o leakage - 0.5 supports fail per 1000 feet of pipe (assuming supports every 20 feet).

Multiple supports failure and 60 feet of pipe fail per 1000 feet of pipe (assuming supports every 20 feet).

Illustrations

none	none			
1.00	1.00			

Damage State Probability:

Fragility Parameters

Median Demand, θ :

1.2

2.4

Data dispersion, β_d :

0.5

0.50

Uncertainty, β_u :

Not Specified

Not Specified

Total Dispersion, β :

By User

By User

Correlation (Yes / No)

NO

Data Quality Not Rated

Documentation Quality Not Rated

Directionality (Yes / No)

NO

Data Relevance Not Rated

Rationality Not Rated

Consequence Functions

Repair Description

Replace failed lateral braces. One repair per 1000 LF.

Replace failed vertical braces. One repair per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.80E+02	3.80E+02	8.30E+02	3.60E+03	3.80E+03	4.25E+03									
Best fit mean:	3.83E+02			3.87E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Cost (Min Qty, Max Qty)	4.18E+02 3.42E+02			4.18E+03 3.42E+03											
CV or beta (Min Qty, Max Qty)	0.60 0.60			0.07 0.07											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.91E-01	4.02E-01	8.79E-01	3.81E-01	4.02E-01	4.50E-01									
Best fit mean:	4.02E-01			4.02E-01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Time (Min Qty, Max Qty)	4.43E-01 3.62E-01			8.05E-01 2.01E-01											
CV or beta (Min Qty, Max Qty)	0.65 0.65			0.26 0.26											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.0E+01	LogNormal	0.65	6.3E+02	LogNormal	0.26									
Embodied Energy (MJ)	1.1E+03	LogNormal	0.65	1.7E+04	LogNormal	0.26									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Date Created:

None

Root Cost Multiplier: 1

Approved (YES / NO)?

By User

Date Generated: 02/26/19

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2016-10-26 - Corrected consequence descriptions.

FEMA P-58 Fragility Specification

NISTIR Classification

D2051.013a

NISTIR Name
Description

Chilled Water Piping - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC D, E, or F, PIPING FRAGILITY
Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Line 744

Construction Quality:	Normal					<div>Quantity RoundingRound Qty?NO</div> <div>Allow sum by floor or building?NO</div> <div>Demand Location (floor above?)Yes</div>
Seismic Installation Conditions:	SDC D, E, F (high seismic design)					
Fragility Unit of Measure:	LF 1000					
Demand Parameter (unit):	Peak Floor Accelerationg					
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Small Leakage at joints - 1 leak per 1000 feet of pipe. Large Leakage w/ major repair - 1 leak per 1000 feet of pipe.					

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	Yes	

Illustrations

none	none			
1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.55	1.1			
Data dispersion, β_d :	0.4	0.40			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	By User	By User			
Correlation (Yes / No)	NO	Data Quality Not Rated		Documentation Quality Not Rated	
Directionality (Yes / No)	NO	Data Relevance Not Rated		Rationality Not Rated	

Consequence Functions

Repair Description

Retighten flange bolts at leaking joints. One repair per 1000 LF. Replace 20 foot sections of pipe where breaks occur. One repair per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	9.00E+01	2.90E+02	7.40E+02	1.50E+03	2.65E+03	4.35E+03									
Best fit mean:	2.79E+02			2.60E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Cost (Min Qty, Max Qty)	3.19E+02 2.61E+02			2.92E+03 2.39E+03											
CV or beta (Min Qty, Max Qty)	0.76 0.76			0.41 0.41											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.53E-02	3.07E-01	7.84E-01	1.59E+00	2.81E+00	4.61E+00									
Best fit mean:	3.07E-01			2.81E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Time (Min Qty, Max Qty)	3.38E-01 2.76E-01			3.09E+00 2.53E+00											
CV or beta (Min Qty, Max Qty)	0.80 0.80			0.48 0.48											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.3E+01	LogNormal	0.80	3.6E+02	LogNormal	0.48									
Embodied Energy (MJ)	5.7E+02	LogNormal	0.80	9.2E+03	LogNormal	0.48									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Date Created:
Approved (YES / NO)?
Official (YES / NO) ?
Author:
Revisions:

None
By User
By User
Not Given
2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

D2051.013b

NISTIR Name

Chilled Water Piping - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC D, E, or F, BRACING FRAGILITY

Description

Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Line 745

Construction Quality:

Normal

Seismic Installation Conditions:

SDC D, E, F (high seismic design)

Fragility Unit of Measure:

LF 1000

Demand Parameter (unit):

Peak Floor Acceleration g

Number of Damage States:

1

Damage State:

DS1

Type of Damage State:

Sequential

DS Hierarchy

Seq(DS1)

Descriptions

Isolated support failure w/o leakage -
0.5 supports fail per 1000 feet of pipe
(assuming supports every 20 feet).

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	Yes	Yes

Illustrations

none					
1.00					

Damage State Probability:

Fragility Parameters

Median Demand, θ :

2.25

Data dispersion, β_d :

0.4

Uncertainty, β_u :

Not Specified

Total Dispersion, β :

By User

Correlation (Yes / No)

NO

Directionality (Yes / No)

NO

Data Quality Not Rated

Data Relevance Not Rated

Documentation Quality Not Rated

Rationality Not Rated

Consequence Functions

Repair Description

Replace failed lateral braces. One repair per 1000 LF.
Replace failed vertical braces. One repair per 1000 LF.

Long Lead Time (Yes / No)

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.80E+02	3.80E+02	8.30E+02												
Best fit mean:	3.83E+02														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	5.00		10.00												
Average Repair Cost (Min Qty, Max Qty)	4.18E+02		3.42E+02												
CV or beta (Min Qty, Max Qty)	0.60		0.60												
Quantity Unit:	Each (1000 ft pipe)														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.91E-01	4.02E-01	8.79E-01												
Best fit mean:	4.02E-01														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	5.00		10.00												
Average Repair Time (Min Qty, Max Qty)	4.43E-01		3.62E-01												
CV or beta (Min Qty, Max Qty)	0.65		0.65												
Quantity Unit:	Each (1000 ft pipe)														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	4.0E+01	LogNormal	0.65												
Embodied Energy (MJ)	1.1E+03	LogNormal	0.65												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%		0.00												
Loss of Life (Median, Dispersion)	0%		0.00												
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00												

Comments:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Date Created:

None

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D2051.014b

Chilled Water Piping - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC D, E, F (OSHDP or sim), BRACING FRAGILITY

Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Line 747

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Special Regulations (e.g. OSHPD) for Piping Installations

SDC D, E, F (high seismic design)

LF 1000

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

Isolated support failure w/o leakage -

0.5 supports fail per 1000 feet of pipe

(assuming supports every 20 feet).

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

3

0.4

Not Specified

By User

NO

NO

Data Quality

Not Rated

Documentation Quality

Not Rated

Data Relevance

Not Rated

Rationality

Not Rated

Consequence Functions

Repair Description

Retighten leaking joints, one per 1000 LF.

Replace 20 ft section of pipe at leaking joints, one per 1000 LF.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau

(Min Qty, Max Qty)

Average Repair Cost

(Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.80E+02

3.80E+02

8.30E+02

3.83E+02

LogNormal

5.00

10.00

4.18E+02

3.42E+02

0.60

0.60

Each (1000 ft pipe)

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau

(Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.91E-01

4.02E-01

8.79E-01

4.02E-01

LogNormal

5.00

10.00

4.43E-01

3.62E-01

0.65

0.65

Each (1000 ft pipe)

Environmental Impacts:

Embodied Carbon (kg CO₂eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

4.0E+01

LogNormal

0.65

1.1E+03

LogNormal

0.65

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

None

By User

By User

Not Given

2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

D2051.021a

NISTIR Name

Chilled Water Piping - Large Diameter Welded Steel - (greater than 2.5 inches in diameter), SDC A or B, PIPING FRAGILITY

Description

Costing based upon 1000 ft segments of pipe, pipe greater than 2.5 inches in diameter

Line 748

Construction Quality:

Normal

Seismic Installation Conditions:

SDC A or B (no seismic design)

Fragility Unit of Measure:

LF 1000

Demand Parameter (unit):

Peak Floor Acceleration g

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	Yes	Yes

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Minor leakage at flange connections - Pipe Break - 1 break per 1000 feet of
1 leak per 1000 feet of pipe. Retighten pipe.
flange at leaking joint.

Illustrations

none	none			
1.00	1.00			

Damage State Probability:

Fragility Parameters

Median Demand, θ :

1.5

2.6

Data dispersion, β_d :

0.4

0.40

Uncertainty, β_u :

Not Specified

Not Specified

Total Dispersion, β :

By User

By User

Correlation (Yes / No)

NO

Data Quality Not Rated

Documentation Quality Not Rated

Directionality (Yes / No)

NO

Data Relevance Not Rated

Rationality Not Rated

Consequence Functions

Repair Description

Retighten leaking joints, one per 1000 LF. Replace 20 ft section of pipe at leaking joints, one per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Cost by Damage State:	1.50E+02	3.50E+02	8.00E+02	1.80E+03	3.35E+03	5.35E+03									
Best fit mean:	3.48E+02 LogNormal			3.21E+03 LogNormal											
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Cost (Min Qty, Max Qty)	7.00E+02 2.10E+02			6.70E+03 2.01E+03											
CV or beta (Min Qty, Max Qty)	0.65 0.65			0.40 0.40											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Time by Damage State:	1.59E-01	3.71E-01	8.47E-01	1.91E+00	3.55E+00	5.66E+00									
Best fit mean:	3.71E-01 LogNormal			3.55E+00 LogNormal											
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Time (Min Qty, Max Qty)	7.41E-01 2.22E-01			7.09E+00 2.13E+00											
CV or beta (Min Qty, Max Qty)	0.70 0.70			0.47 0.47											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	3.3E+01	LogNormal	0.70	4.8E+02	LogNormal	0.47									
Embodied Energy (MJ)	8.6E+02	LogNormal	0.70	1.2E+04	LogNormal	0.47									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Date Created:

None

Root Cost Multiplier: 1

Approved (YES / NO)?

By User

Date Generated: 02/26/19

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2016-10-26 - Corrected consequence descriptions.

FEMA P-58 Fragility Specification

NISTIR Classification

D2051.021b

NISTIR Name

Chilled Water Piping - Large Diameter Welded Steel - (greater than 2.5 inches in diameter), SDC A or B, BRACING FRAGILITY

Description

Costing based upon 1000 ft segments of pipe, pipe greater than 2.5 inches in diameter

Line 749

Construction Quality:

Normal

Seismic Installation Conditions:

SDC A or B (no seismic design)

Fragility Unit of Measure:

LF 1000

Demand Parameter (unit):

Peak Floor Acceleration g

Number of Damage States:

1

Damage State:

DS1

Type of Damage State:

Sequential

DS Hierarchy

Seq(DS1)

Descriptions

Vertical Brace Failure - 1 failure per 1000 feet of pipe

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	Yes	Yes

Illustrations

none				
1.00				

Damage State Probability:

Fragility Parameters

Median Demand, θ :

2.25

Data dispersion, β_d :

0.4

Uncertainty, β_u :

Not Specified

Total Dispersion, β_t :

By User

Correlation (Yes / No)

NO

Directionality (Yes / No)

NO

Data Quality Not Rated

Data Relevance Not Rated

Documentation Quality Not Rated

Rationality Not Rated

Consequence Functions

Repair Description

Replace failed supports, one per 1000 LF.

Long Lead Time (Yes / No)

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.50E+02	3.50E+02	8.00E+02												
Best fit mean:	3.48E+02														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00														
Average Repair Cost (Min Qty, Max Qty)	7.00E+02 2.10E+02														
CV or beta (Min Qty, Max Qty)	0.65 0.65														
Quantity Unit:	Each (1000 ft pipe)														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.59E-01	3.71E-01	8.47E-01												
Best fit mean:	3.71E-01														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00														
Average Repair Time (Min Qty, Max Qty)	7.41E-01 2.22E-01														
CV or beta (Min Qty, Max Qty)	0.70 0.70														
Quantity Unit:	Each (1000 ft pipe)														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	3.3E+01	LogNormal	0.70												
Embodied Energy (MJ)	8.6E+02	LogNormal	0.70												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0% 0.00														
Loss of Life (Median, Dispersion)	0% 0.00														
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00														

Comments:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Date Created:

None

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

D2051.022a

NISTIR Name

Chilled Water Piping - Large Diameter Welded Steel - (greater than 2.5 inches in diameter), SDC C, PIPING FRAGILITY

Description

Costing based upon 1000 ft segments of pipe, pipe greater than 2.5 inches in diameter

Line 750

Construction Quality:

Normal

Seismic Installation Conditions:

SDC C (low seismic design)

Fragility Unit of Measure:

LF 1000

Demand Parameter (unit):

Peak Floor Acceleration g

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	Yes	Yes

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Minor leakage at flange connections - 1 leak per 1000 feet of pipe.
Pipe Break - 1 break per 1000 feet of pipe.

Illustrations

none	none			
1.00	1.00			

Damage State Probability:

Fragility Parameters

Median Demand, θ :

1.5

2.6

Data dispersion, β_d :

0.4

0.40

Uncertainty, β_u :

Not Specified

Not Specified

Total Dispersion, β :

By User

By User

Correlation (Yes / No)

NO

Data Quality Not Rated

Documentation Quality Not Rated

Directionality (Yes / No)

NO

Data Relevance Not Rated

Rationality Not Rated

Consequence Functions

Repair Description

Retighten leaking joints, one per 1000 LF.
Replace 20 ft section of pipe at leaking joints, one per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.50E+02	3.50E+02	8.00E+02	1.80E+03	3.35E+03	5.35E+03									
Best fit mean:	3.48E+02 LogNormal			3.21E+03 LogNormal											
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Cost (Min Qty, Max Qty)	7.00E+02 2.10E+02			6.70E+03 2.01E+03											
CV or beta (Min Qty, Max Qty)	0.65 0.65			0.40 0.40											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.59E-01	3.71E-01	8.47E-01	1.91E+00	3.55E+00	5.66E+00									
Best fit mean:	3.71E-01 LogNormal			3.55E+00 LogNormal											
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Time (Min Qty, Max Qty)	7.41E-01 2.22E-01			7.09E+00 2.13E+00											
CV or beta (Min Qty, Max Qty)	0.70 0.70			0.47 0.47											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	3.3E+01	LogNormal	0.70	4.8E+02	LogNormal	0.47									
Embodied Energy (MJ)	8.6E+02	LogNormal	0.70	1.2E+04	LogNormal	0.47									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Date Created:

None

Root Cost Multiplier: 1

Approved (YES / NO)?

By User

Date Generated: 02/26/19

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2016-10-26 - Corrected consequence descriptions.

FEMA P-58 Fragility Specification

NISTIR Classification

D2051.023a

NISTIR Name

Chilled Water Piping - Large Diameter Welded Steel - (greater than 2.5 inches in diameter), SDC D, E, or F, PIPING FRAGILITY

Description

Costing based upon 1000 ft segments of pipe, pipe greater than 2.5 inches in diameter

Line 751

Construction Quality:

Normal

Seismic Installation Conditions:

SDC D, E, F (high seismic design)

Fragility Unit of Measure:

LF 1000

Demand Parameter (unit):

Peak Floor Acceleration g

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Minor leakage at flange connections - 1 leak per 1000 feet of pipe.
Pipe Break - 1 break per 1000 feet of pipe.

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	Yes	Yes

Illustrations

none	none			
1.00	1.00			

Damage State Probability:

Fragility Parameters

Median Demand, θ :

2.25

4.1

Data dispersion, β_d :

0.4

0.40

Uncertainty, β_u :

Not Specified

Not Specified

Total Dispersion, β :

By User

By User

Correlation (Yes / No)

NO

Data Quality Not Rated

Documentation Quality Not Rated

Directionality (Yes / No)

NO

Data Relevance Not Rated

Rationality Not Rated

Consequence Functions

Repair Description

Retighten leaking joints, one per 1000 LF.
Replace 20 ft section of pipe at leaking joints, one per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.50E+02	3.50E+02	8.00E+02	1.80E+03	3.35E+03	5.35E+03									
Best fit mean:	3.48E+02 LogNormal			3.21E+03 LogNormal											
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Cost (Min Qty, Max Qty)	7.00E+02 2.10E+02			6.70E+03 2.01E+03											
CV or beta (Min Qty, Max Qty)	0.65 0.65			0.40 0.40											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.59E-01	3.71E-01	8.47E-01	1.91E+00	3.55E+00	5.66E+00									
Best fit mean:	3.71E-01 LogNormal			3.55E+00 LogNormal											
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Time (Min Qty, Max Qty)	7.41E-01 2.22E-01			7.09E+00 2.13E+00											
CV or beta (Min Qty, Max Qty)	0.70 0.70			0.47 0.47											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	3.6E+01	LogNormal	0.70	3.6E+01	LogNormal	0.47									
Embodied Energy (MJ)	1.0E+03	LogNormal	0.70	1.0E+03	LogNormal	0.47									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Date Created:

None

Root Cost Multiplier: 1

Approved (YES / NO)?

By User

Date Generated: 02/26/19

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2016-10-26 - Corrected consequence descriptions.

FEMA P-58 Fragility Specification

NISTIR Classification

D2051.023b

NISTIR Name
Description

Chilled Water Piping - Large Diameter Welded Steel - (greater than 2.5 inches in diameter), SDC D, E, or F, BRACING FRAGILITY
Costing based upon 1000 ft segments of pipe, pipe greater than 2.5 inches in diameter

Line 752

Construction Quality:	Normal					<div>Quantity RoundingRound Qty?NO</div> <div>Allow sum by floor or building?NO</div> <div>Demand Location (floor above)?Yes</div>
Seismic Installation Conditions:	SDC D, E, F (high seismic design)					
Fragility Unit of Measure:	LF 1000					
Demand Parameter (unit):	Peak Floor Accelerationg					
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Lateral Brace Failure - 0.01 failures per 20 foot pipe section.		Vertical Brace Failure - 1 failure per 1000 feet of pipe.			

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations

none	none			
1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	1.5	2.25			
Data dispersion, β_d :	0.4	0.40			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	By User	By User			
Correlation (Yes / No)	NO	Data Quality Not Rated		Documentation Quality Not Rated	
Directionality (Yes / No)	NO	Data Relevance Not Rated		Rationality Not Rated	

Consequence Functions
Repair Description

Replace failed supports, one per 1000 LF. Replace failed supports, one per 1000 LF.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.50E+02	3.50E+02	8.00E+02	1.50E+02	3.50E+02	8.00E+02									
Best fit mean:	3.48E+02			3.48E+02											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Cost (Min Qty, Max Qty)	7.00E+02 2.10E+02			7.00E+02 2.10E+02											
CV or beta (Min Qty, Max Qty)	0.65 0.65			0.65 0.65											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.59E-01	3.71E-01	8.47E-01	1.59E-01	3.71E-01	8.47E-01									
Best fit mean:	3.71E-01			3.71E-01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Time (Min Qty, Max Qty)	7.41E-01 2.22E-01			7.41E-01 2.22E-01											
CV or beta (Min Qty, Max Qty)	0.70 0.70			0.70 0.70											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	3.3E+01	LogNormal	0.70	4.8E+02	LogNormal	0.70									
Embodied Energy (MJ)	8.6E+02	LogNormal	0.70	1.2E+04	LogNormal	0.70									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										

Comments: Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.
Date Created: None Root Cost Multiplier: 1
Approved (YES / NO)? By User Date Generated: 02/26/19
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2016-10-26 - Corrected consequence descriptions.

FEMA P-58 Fragility Specification

NISTIR Classification

D2051.024a

Line 753

NISTIR Name
Description

Chilled Water Piping - Large Diameter Welded Steel - (greater than 2.5 inches in diameter), SDC D, E, or F (OSHDP or sim), PIPING FRAGILITY
Costing based upon 1000 ft segments of pipe, pipe greater than 2.5 inches in diameter

Construction Quality: Special Regulation (e.g. OSHPD) for Piping Installations
Seismic Installation Conditions: SDC D, E, F (high seismic design)

Fragility Unit of Measure: LF 1000
Demand Parameter (unit): Peak Floor Acceleration g

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	Yes	

Number of Damage States:	2				
Damage State:	DS1	DS2			
Type of Damage State:	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Minor leakage at flange connections - 1 leak per 1000 feet of pipe.	Pipe Break - 1 break per 1000 feet of pipe.			

Illustrations

none	none			
1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	2.25	4.1			
Data dispersion, β_d :	0.4	0.40			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	By User	By User			
Correlation (Yes / No)	NO	Data Quality Not Rated		Documentation Quality Not Rated	
Directionality (Yes / No)	NO	Data Relevance Not Rated		Rationality Not Rated	

Consequence Functions
Repair Description

Retighten leaking joints, one per 1000 LF. Replace 20 ft section of pipe at leaking joints, one per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.50E+02	3.50E+02	8.00E+02	1.80E+03	3.35E+03	5.35E+03									
Best fit mean:	3.48E+02			3.21E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Cost (Min Qty, Max Qty)	7.00E+02 2.10E+02			6.70E+03 2.01E+03											
CV or beta (Min Qty, Max Qty)	0.65 0.65			0.40 0.40											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.59E-01	3.71E-01	8.47E-01	1.91E+00	3.55E+00	5.66E+00									
Best fit mean:	3.71E-01			3.55E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Time (Min Qty, Max Qty)	7.41E-01 2.22E-01			7.09E+00 2.13E+00											
CV or beta (Min Qty, Max Qty)	0.70 0.70			0.47 0.47											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	3.6E+01	LogNormal	0.70	3.6E+01	LogNormal	0.47									
Embodied Energy (MJ)	1.0E+03	LogNormal	0.70	1.0E+03	LogNormal	0.47									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										

Comments: Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Date Created: None
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier: 1
Date Generated: 02/26/19

Line 754

Chilled Water Piping - Large Diameter Welded Steel - (greater than 2.5 inches in diameter), SDC D, E, or F (OSHDP or sim), BRACING FRAGILITY
Costing based upon 1000 ft segments of pipe, pipe greater than 2.5 inches in diameter

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Descriptions	Vertical Brace Failure - 1 failure per 1000 feet of pipe.	Vertical Brace Failure - 1 failure per 1000 feet of pipe.

none	none			
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Documentation Quality Not Rated
Rationality Not Rated

Replace failed supports, one per 1000 LF. Replace failed supports, one per 1000 LF.

NO

Comments:	Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.		
Date Created:	None	Root Cost Multiplier:	1
Approved (YES / NO)?	By User	Date Generated:	02/26/19
Official (YES / NO) ?	By User		
Author:	Not Given		
Revisions:	2016-10-26 - Corrected consequence descriptions.		

FEMA P-58 Fragility Specification

NISTIR Classification

D2061.011a

NISTIR Name
Description

Steam Piping - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC A or B, PIPING FRAGILITY
Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Line 755

Construction Quality:

Normal

Seismic Installation Conditions:

SDC A or B (no seismic design)

Fragility Unit of Measure:

LF 1000

Demand Parameter (unit):

Peak Floor Acceleration g

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Small Leakage at joints - 1 leak per 1000 feet of pipe.
Large Leakage w/ major repair - 1 leak per 1000 feet of pipe. Replace one 20 ft section per 1000 LF pipe.

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	Yes	Yes

Illustrations

none	none			
1.00	1.00			

Damage State Probability:

Fragility Parameters

Median Demand, θ :

0.55

1.1

Data dispersion, β_d :

0.4

0.40

Uncertainty, β_u :

Not Specified
By User

Not Specified
By User

Correlation (Yes / No)

NO

Data Quality Not Rated

Documentation Quality Not Rated

Directionality (Yes / No)

NO

Data Relevance Not Rated

Rationality Not Rated

Consequence Functions

Repair Description

Retighten leaking joints, one per 1000 LF.
Replace 20 ft section of pipe at leaking joints, one per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	9.00E+01	2.90E+02	7.40E+02	1.50E+03	2.65E+03	4.35E+03									
Best fit mean:	2.79E+02 LogNormal			2.60E+03 LogNormal											
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Cost (Min Qty, Max Qty)	3.19E+02 2.61E+02			2.92E+03 2.39E+03											
CV or beta (Min Qty, Max Qty)	0.76 0.76			0.41 0.41											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.53E-02	3.07E-01	7.84E-01	1.59E-01	2.81E-01	4.61E-01									
Best fit mean:	3.07E-01 LogNormal			2.81E-01 LogNormal											
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Time (Min Qty, Max Qty)	3.38E-01 2.76E-01			5.61E-01 1.40E-01											
CV or beta (Min Qty, Max Qty)	0.80 0.80			0.48 0.48											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.3E+01	LogNormal	0.80	3.6E+02	LogNormal	0.48									
Embodied Energy (MJ)	5.7E+02	LogNormal	0.80	9.2E+03	LogNormal	0.48									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Date Created:

Not Given

Root Cost Multiplier: 1

Approved (YES / NO)?

By User

Date Generated: 02/26/19

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2016-10-26 - Corrected consequence descriptions.

FEMA P-58 Fragility Specification

NISTIR Classification

D2061.011b

NISTIR Name

Steam Piping - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC A or B, BRACING FRAGILITY

Description

Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Line 756

Construction Quality:

Normal

Seismic Installation Conditions:

SDC A or B (no seismic design)

Fragility Unit of Measure:

LF 1000

Demand Parameter (unit):

Peak Floor Acceleration g

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	Yes	Yes

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Isolated support failure w/o leakage - 1
supports fail per 1000 feet of pipe
(assuming supports every 20 feet).

Multiple supports failure and 60 feet of
pipe fail per 1000 feet of pipe (assuming
supports every 20 feet).

Illustrations

none	none			
1.00	1.00			

Damage State Probability:

Fragility Parameters

Median Demand, θ :

1.2

2.4

Data dispersion, β_d :

0.5

0.50

Uncertainty, β_u :

Not Specified

Not Specified

Total Dispersion, β :

By User

By User

Correlation (Yes / No)

NO

Data Quality Not Rated

Documentation Quality Not Rated

Directionality (Yes / No)

NO

Data Relevance Not Rated

Rationality Not Rated

Consequence Functions

Repair Description

Replace failed supports, one per 1000 LF.

Replace 60 ft pipe and supports per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.80E+02	3.80E+02	8.30E+02	3.60E+03	3.80E+03	4.25E+03									
Best fit mean:	3.83E+02			3.87E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Cost (Min Qty, Max Qty)	4.18E+02 3.42E+02			4.18E+03 3.42E+03											
CV or beta (Min Qty, Max Qty)	0.60 0.60			0.07 0.07											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.91E-01	4.02E-01	8.79E-01	3.81E-01	4.02E-01	4.50E-01									
Best fit mean:	4.02E-01			4.02E-01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Time (Min Qty, Max Qty)	4.43E-01 3.62E-01			8.05E-01 2.01E-01											
CV or beta (Min Qty, Max Qty)	0.65 0.65			0.26 0.26											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.0E+01	LogNormal	0.65	6.3E+02	LogNormal	0.26									
Embodied Energy (MJ)	1.1E+03	LogNormal	0.65	1.7E+04	LogNormal	0.26									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Date Created:

Not Given

Root Cost Multiplier: 1

Approved (YES / NO)?

By User

Date Generated: 02/26/19

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2016-10-26 - Corrected consequence descriptions.

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D2061.012a
Steam Piping - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC C, PIPING FRAGILITY
Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Line 757

Construction Quality:		Normal			<div>Quantity Rounding</div> <div>Round Qty?</div> <div>NO</div> <div>Allow sum by floor or building?</div> <div>NO</div> <div>Demand Location (floor above?)</div> <div>Yes</div>	
Seismic Installation Conditions:		SDC C (low seismic design)				
Fragility Unit of Measure:		LF 1000				
Demand Parameter (unit):		Peak Floor Acceleration g				
Number of Damage States:		2				
Damage State:		DS1		DS2		
Type of Damage State:		Sequential		Sequential		
DS Hierarchy		Seq(DS1,DS2)				
Descriptions		Small Leakage at joints - 1 leak per 1000 feet of pipe.				
		Large Leakage w/ major repair - 1 leak per 1000 feet of pipe. Replace one 20 ft section per 1000 LF pipe.				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	Yes	Yes

Illustrations

none	none			
1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.55	1.1			
Data dispersion, β_d :	0.4	0.40			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	By User	By User			
Correlation (Yes / No)	NO	Data Quality Not Rated		Documentation Quality Not Rated	
Directionality (Yes / No)	NO	Data Relevance Not Rated		Rationality Not Rated	

Consequence Functions

Repair Description

Retighten flange bolts at leaking joints, 1 joint per 1000 LF.
Replace 20 foot sections of pipe where breaks occur, one per 1000 LF.

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	9.00E+01	2.90E+02	7.40E+02	1.50E+03	2.65E+03	4.35E+03									
Best fit mean:	2.79E+02			2.60E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Cost (Min Qty, Max Qty)	3.19E+02 2.61E+02			2.92E+03 2.39E+03											
CV or beta (Min Qty, Max Qty)	0.76 0.76			0.41 0.41											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.53E-02	3.07E-01	7.84E-01	1.59E-01	2.81E-01	4.61E-01									
Best fit mean:	3.07E-01			2.81E-01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Time (Min Qty, Max Qty)	3.38E-01 2.76E-01			5.61E-01 1.40E-01											
CV or beta (Min Qty, Max Qty)	0.80 0.80			0.48 0.48											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.3E+01	LogNormal	0.80	3.6E+02	LogNormal	0.48									
Embodied Energy (MJ)	5.7E+02	LogNormal	0.80	9.2E+03	LogNormal	0.48									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Not Given

By User

By User

Not Given

2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D2061.012b
Steam Piping - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC C, BRACING FRAGILITY
Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Line 758

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal
SDC C (low seismic design)
LF 1000
g
2
DS1
Sequential
Seq(DS1,DS2)
Isolated support failure w/o leakage - 1 supports fail per 1000 feet of pipe (assuming supports every 20 feet).
Multiple supports failure and 60 feet of pipe fail per 1000 feet of pipe (assuming supports every 20 feet).

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Damage State Probability:

Correlation (Yes / No)

Directionality (Yes / No)

Consequence Functions

Repair Description

1.00

1.00

1.2

0.5

Not Specified

By User

2.4

0.50

Not Specified

By User

NO

NO

Data Quality

Not Rated

Data Relevance

Not Rated

Documentation Quality

Not Rated

Rationality

Not Rated

Replace failed supports, one per 1000 LF.

Replace 60 ft pipe and supports per 1000 LF.

Illustrations					
	none	none			
	1.00	1.00			

Fragility Parameters					
Median Demand, θ :	1.2	2.4			
Data dispersion, β_d :	0.5	0.50			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	By User	By User			

Correlation (Yes / No)	NO	Data Quality	Not Rated	Documentation Quality	Not Rated
Directionality (Yes / No)	NO	Data Relevance	Not Rated	Rationality	Not Rated

Consequence Functions					
Repair Description	Replace failed supports, one per 1000 LF.	Replace 60 ft pipe and supports per 1000 LF.			

Long Lead Time (Yes / No)	NO			NO														
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀			
Repair Cost by Damage State:	1.80E+02	3.80E+02	8.30E+02	3.60E+03	3.80E+03	4.25E+03												
Best fit mean:	3.83E+02			3.87E+03														
Best Fit Distribution:	LogNormal			LogNormal														
Quantity Plateau (Min Qty, Max Qty)	5.00		10.00	5.00		10.00												
Average Repair Cost (Min Qty, Max Qty)	4.18E+02		3.42E+02	4.18E+03		3.42E+03												
CV or beta (Min Qty, Max Qty)	0.60		0.60	0.07		0.07												
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀			
Repair Time by Damage State:	1.91E-01	4.02E-01	8.79E-01	3.81E-01	4.02E-01	4.50E-01												
Best fit mean:	4.02E-01			4.02E-01														
Best Fit Distribution:	LogNormal			LogNormal														
Quantity Plateau (Min Qty, Max Qty)	5.00		10.00	5.00		10.00												
Average Repair Time (Min Qty, Max Qty)	4.43E-01		3.62E-01	8.05E-01		2.01E-01												
CV or beta (Min Qty, Max Qty)	0.65		0.65	0.26		0.26												
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta			
Embodied Carbon (kg CO2eq)	4.0E+01	LogNormal	0.65	6.3E+02	LogNormal	0.26												
Embodied Energy (MJ)	1.1E+03	LogNormal	0.65	1.7E+04	LogNormal	0.26												
LifeSafety Hazard:																		
Potential non-collapse casualties? (Yes / No)	NO			NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00													
Post-event Tagging Flag:	NO			NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00													

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.
Not Given
By User
By User
Not Given
2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

D2061.013a

NISTIR Name
Description

Steam Piping - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC D, E, or F, PIPING FRAGILITY
Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Line 759

Construction Quality:		Normal			<div>Quantity Rounding</div> <div>Round Qty?</div> <div>NO</div> <div>Allow sum by floor or building?</div> <div>NO</div> <div>Demand Location (floor above?)</div> <div>Yes</div>	
Seismic Installation Conditions:		SDC D, E, F (high seismic design)				
Fragility Unit of Measure:		LF 1000				
Demand Parameter (unit):		Peak Floor Acceleration g				
Number of Damage States:		2				
Type of Damage State:		DS1		DS2		
		Sequential		Sequential		
DS Hierarchy		Seq(DS1,DS2)				
Descriptions		Small Leakage at joints - 1 leak per 1000 feet of pipe.				
		Large Leakage w/ major repair - 1 leak per 1000 feet of pipe. Replace one 20 ft section per 1000 LF pipe.				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	Yes	

Illustrations

none	none			
1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.55	1.1			
Data dispersion, β_d :	0.4	0.40			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	By User	By User			
Correlation (Yes / No)	NO	Data Quality Not Rated		Documentation Quality Not Rated	
Directionality (Yes / No)	NO	Data Relevance Not Rated		Rationality Not Rated	

Consequence Functions
Repair Description

Retighten flange bolts at leaking joints, 1 joint per 1000 LF.
Replace 20 foot sections of pipe where breaks occur, one per 1000 LF.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	9.00E+01	2.90E+02	7.40E+02	1.50E+03	2.65E+03	4.35E+03									
Best fit mean:	2.79E+02			2.60E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Cost (Min Qty, Max Qty)	3.19E+02 2.61E+02			2.92E+03 2.39E+03											
CV or beta (Min Qty, Max Qty)	0.76 0.76			0.41 0.41											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.53E-02	3.07E-01	7.84E-01	1.59E+00	2.81E+00	4.61E+00									
Best fit mean:	3.07E-01			2.81E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Time (Min Qty, Max Qty)	3.38E-01 2.76E-01			3.09E+00 2.53E+00											
CV or beta (Min Qty, Max Qty)	0.80 0.80			0.48 0.48											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.3E+01	LogNormal	0.80	3.6E+02	LogNormal	0.48									
Embodied Energy (MJ)	5.7E+02	LogNormal	0.80	9.2E+03	LogNormal	0.48									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments: Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D2061.013b

Steam Piping - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC D, E, or F, BRACING FRAGILITY

Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Line760

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

SDC D, E, F (high seismic design)

LF 1000

Peak Floor Accelerationg

1

DS1

Sequential

Seq(DS1)

Isolated support failure w/o leakage - 1 supports fail per 1000 feet of pipe (assuming supports every 20 feet).

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

2.25

0.4

Not Specified

By User

NO

NO

Data Quality

Not Rated

Documentation Quality

Not Rated

Data Relevance

Not Rated

Rationality

Not Rated

Consequence Functions

Repair Description

Replace failed supports, one per 1000 LF.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.80E+02

3.80E+02

8.30E+02

3.83E+02

LogNormal

5.00

10.00

4.18E+02

3.42E+02

0.60

0.60

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.91E-01

4.02E-01

8.79E-01

4.02E-01

LogNormal

5.00

10.00

4.43E-01

3.62E-01

0.65

0.65

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO₂eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

4.0E+01

LogNormal

0.65

1.1E+03

LogNormal

0.65

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Not Given

By User

By User

Not Given

2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

D2061.014a

NISTIR Name
Description

Steam Piping - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC D, E, or F (OSHDP or sim), PIPING FRAGILITY
Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Line 761

Construction Quality:

Special Regulations (e.g. OSHPD) for Piping Installations

Seismic Installation Conditions:

SDC D, E, F (high seismic design)

Fragility Unit of Measure:

LF 1000

Demand Parameter (unit):

Peak Floor Acceleration g

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Small Leakage at joints - 1 leak per 1000 feet of pipe.
Large Leakage w/ major repair - 1 leak per 1000 feet of pipe. Replace one 20 ft section per 1000 LF pipe.

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	Yes	Yes

Illustrations

none	none			
1.00	1.00			

Damage State Probability:

Fragility Parameters

Median Demand, θ :

0.55

1.1

Data dispersion, β_d :

0.4

0.40

Uncertainty, β_u :

Not Specified

Not Specified

Total Dispersion, β :

By User

By User

Correlation (Yes / No)

NO

Data Quality Not Rated

Documentation Quality Not Rated

Directionality (Yes / No)

NO

Data Relevance Not Rated

Rationality Not Rated

Consequence Functions

Repair Description

Retighten flange bolts at leaking joints, 1 joint per 1000 LF.
Replace 20 foot sections of pipe where breaks occur, one per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	9.00E+01	2.90E+02	7.40E+02	1.50E+03	2.65E+03	4.35E+03									
Best fit mean:	2.79E+02			2.60E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Cost (Min Qty, Max Qty)	3.19E+02 2.61E+02			2.92E+03 2.39E+03											
CV or beta (Min Qty, Max Qty)	0.76 0.76			0.41 0.41											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.53E-02	3.07E-01	7.84E-01	1.59E+00	2.81E+00	4.61E+00									
Best fit mean:	3.07E-01			2.81E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Time (Min Qty, Max Qty)	3.38E-01 2.76E-01			3.09E+00 2.53E+00											
CV or beta (Min Qty, Max Qty)	0.80 0.80			0.48 0.48											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.3E+01	LogNormal	0.80	3.6E+02	LogNormal	0.48									
Embodied Energy (MJ)	5.7E+02	LogNormal	0.80	9.2E+03	LogNormal	0.48									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Date Created:

Not Given

Root Cost Multiplier: 1

Approved (YES / NO)?

By User

Date Generated: 02/26/19

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2016-10-26 - Corrected consequence descriptions.

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D2061.014b

Steam Piping - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC D, E, or F (OSHDP or sim), BRACING FRAGILITY

Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Line 762

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Special Regulations (e.g. OSHPD) for Piping Installations

SDC D, E, F (high seismic design)

LF 1000

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

Isolated support failure w/o leakage - 1

supports fail per 1000 feet of pipe

(assuming supports every 20 feet).

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

3

0.4

Not Specified

By User

NO

NO

Data Quality

Not Rated

Documentation Quality

Not Rated

Data Relevance

Not Rated

Rationality

Not Rated

Consequence Functions

Repair Description

Replace failed supports, one per 1000 LF.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau

(Min Qty, Max Qty)

Average Repair Cost

(Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.80E+02

3.80E+02

8.30E+02

3.83E+02

LogNormal

5.00

10.00

4.18E+02

3.42E+02

0.60

0.60

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau

(Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.91E-01

4.02E-01

8.79E-01

4.02E-01

LogNormal

5.00

10.00

4.43E-01

3.62E-01

0.65

0.65

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO₂eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

4.0E+01

LogNormal

0.65

1.1E+03

LogNormal

0.65

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Not Given

By User

By User

Not Given

2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D2061.021a

Steam Piping - Large Diameter Welded Steel - (greater than 2.5 inches in diameter), SDC A or B, PIPING FRAGILITY

Costing based upon 1000 ft segments of pipe, pipe greater than 2.5 inches in diameter

Line763

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

SDC A or B (no seismic design)

LF 1000

Peak Floor Acceleration

2

DS1

Sequential

Seq(DS1,DS2)

Minor leakage at flange connections - 1 leak per 1000 feet of pipe.

Pipe Break - 1 break per 1000 feet of pipe. Replace one 20 ft section per 1000 LF pipe.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

none

1.00

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.5

0.4

Not Specified

By User

2.6

0.40

Not Specified

By User

NO

NO

Data Quality

Not Rated

Documentation Quality

Not Rated

Data Relevance

Not Rated

Rationality

Not Rated

Consequence Functions

Repair Description

Retighten flange bolts at leaking joints, 1 joint per 1000 LF.

Replace 20 foot sections of pipe where breaks occur, one per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.50E+02

3.50E+02

8.00E+02

3.48E+02

LogNormal

5.00

10.00

7.00E+02

2.10E+02

0.65

0.65

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

1.80E+03

3.35E+03

5.35E+03

3.21E+03

LogNormal

5.00

10.00

6.70E+03

2.01E+03

0.40

0.40

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.59E-01

3.71E-01

8.47E-01

3.71E-01

LogNormal

5.00

10.00

7.41E-01

2.22E-01

0.70

0.70

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

1.91E+00

3.55E+00

5.66E+00

3.55E+00

LogNormal

5.00

10.00

7.09E+00

2.13E+00

0.47

0.47

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

3.3E+01

LogNormal

0.70

4.8E+02

LogNormal

0.47

Median Cost

Best Fit

CV or Beta

8.6E+02

LogNormal

0.70

1.2E+04

LogNormal

0.47

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Not Given

By User

By User

Not Given

2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

D2061.022a

NISTIR Name

Steam Piping - Large Diameter Welded Steel - (greater than 2.5 inches in diameter), SDC C, PIPING FRAGILITY

Description

Costing based upon 1000 ft segments of pipe, pipe greater than 2.5 inches in diameter

Line 764

Construction Quality:

Normal

Seismic Installation Conditions:

SDC C (low seismic design)

Fragility Unit of Measure:

LF 1000

Demand Parameter (unit):

Peak Floor Acceleration g

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	Yes	Yes

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Minor leakage at flange connections - Pipe Break - 1 break per 1000 feet of pipe. - Replace one 20 ft section per 1000 LF pipe.
1 leak per 1000 feet of pipe.

Illustrations

none	none			
1.00	1.00			

Damage State Probability:

Fragility Parameters

Median Demand, θ :

1.5

2.6

Data dispersion, β_d :

0.4

0.40

Uncertainty, β_u :

Not Specified

Not Specified

Total Dispersion, β :

By User

By User

Correlation (Yes / No)

NO

Data Quality Not Rated

Documentation Quality Not Rated

Directionality (Yes / No)

NO

Data Relevance Not Rated

Rationality Not Rated

Consequence Functions

Repair Description

Retighten flange bolts at leaking joints, 1 joint per 1000 LF. Replace 20 foot sections of pipe where breaks occur, one per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.50E+02	3.50E+02	8.00E+02	1.80E+03	3.35E+03	5.35E+03									
Best fit mean:	3.48E+02			3.21E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Cost (Min Qty, Max Qty)	7.00E+02 2.10E+02			6.70E+03 2.01E+03											
CV or beta (Min Qty, Max Qty)	0.65 0.65			0.40 0.40											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.59E-01	3.71E-01	8.47E-01	1.91E+00	3.55E+00	5.66E+00									
Best fit mean:	3.71E-01			3.55E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Time (Min Qty, Max Qty)	7.41E-01 2.22E-01			7.09E+00 2.13E+00											
CV or beta (Min Qty, Max Qty)	0.70 0.70			0.47 0.47											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	3.3E+01	LogNormal	0.70	4.8E+02	LogNormal	0.47									
Embodied Energy (MJ)	8.6E+02	LogNormal	0.70	1.2E+04	LogNormal	0.47									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Date Created:

Not Given

Root Cost Multiplier: 1

Approved (YES / NO)?

By User

Date Generated: 02/26/19

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2016-10-26 - Corrected consequence descriptions.

FEMA P-58 Fragility Specification

NISTIR Classification

D2061.023a

NISTIR Name
Description

Steam Piping - Large Diameter Welded Steel - (greater than 2.5 inches in diameter), SDC D, E, or F, PIPING FRAGILITY
Costing based upon 1000 ft segments of pipe, pipe greater than 2.5 inches in diameter

Line 419

Construction Quality:	Normal				<div>Quantity RoundingRound Qty?NO</div> <div>Allow sum by floor or building?NO</div> <div>Demand Location (floor above?)Yes</div>
Seismic Installation Conditions:	SDC D, E, F (high seismic design)				
Fragility Unit of Measure:	LF 1000				
Demand Parameter (unit):	Peak Floor Accelerationg				
Number of Damage States:	2				
Damage State:	DS1		DS2		
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Minor leakage at flange connections - 1 leak per 1000 feet of pipe.				Pipe Break - 1 break per 1000 feet of pipe

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	Yes	

Illustrations

none	none			
1.00	1.00			

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	2.25	4.1		
Data dispersion, β_d :	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified		
Total Dispersion, β :	0.4	0.4		
Correlation (Yes / No)	NO	Data Quality Marginal	Documentation Quality Marginal	
Directionality (Yes / No)	NO	Data Relevance Superior	Rationality Marginal	

Consequence Functions

Repair Description

Retighten flange bolts at leaking joints, 1 joint per 1000 LF.
Replace 20 foot sections of pipe where breaks occur, one per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.50E+02	3.50E+02	8.00E+02	1.80E+03	3.35E+03	5.35E+03									
Best fit mean:	3.48E+02			3.21E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Cost (Min Qty, Max Qty)	7.00E+02 2.10E+02			6.70E+03 2.01E+03											
CV or beta (Min Qty, Max Qty)	0.65 0.65			0.40 0.40											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.59E-01	3.71E-01	8.47E-01	1.91E+00	3.55E+00	5.66E+00									
Best fit mean:	3.71E-01			3.55E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Time (Min Qty, Max Qty)	7.41E-01 2.22E-01			7.09E+00 2.13E+00											
CV or beta (Min Qty, Max Qty)	0.70 0.70			0.47 0.47											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	3.3E+01	LogNormal	0.70	4.8E+02	LogNormal	0.47									
Embodied Energy (MJ)	8.6E+02	LogNormal	0.70	1.2E+04	LogNormal	0.47									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			YES											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			10 SF											
Serious Injury (Median, Dispersion)	0% 0.00			5% 0.50											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Date Created:
Approved (YES / NO)?
Official (YES / NO) ?
Author:
Revisions:

Not Given
By User
By User
Not Given
2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D2061.023b

Steam Piping - Large Diameter Welded Steel - (greater than 2.5 inches in diameter), SDC D, E, or F, BRACING FRAGILITY

Costing based upon 1000 ft segments of pipe, pipe greater than 2.5 inches in diameter

Line 420

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

SDC D, E, F (high seismic design)

LF 1000

Peak Floor Acceleration

2

DS1

Sequential

Seq(DS1,DS2)

Lateral Brace Failure - 1 failure per 1000 feet of pipe .

Vertical Brace Failure - 1 failure per 1000 feet of pipe

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

none

1.00

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.5

Not Specified

Not Specified

0.4

NO

NO

2.25

Not Specified

Not Specified

0.4

Data Quality Marginal

Data Relevance Superior

Documentation Quality Marginal

Rationality Marginal

Consequence Functions

Repair Description

Replace failed supports, one per 1000 LF.

Replace failed supports, one per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.50E+02

3.50E+02

8.00E+02

LogNormal

5.00

10.00

7.00E+02

2.10E+02

0.65

0.65

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

1.50E+02

3.50E+02

8.00E+02

LogNormal

5.00

10.00

7.00E+02

2.10E+02

0.65

0.65

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.59E-01

3.71E-01

8.47E-01

LogNormal

5.00

10.00

7.41E-01

2.22E-01

0.70

0.70

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

1.59E-01

3.71E-01

8.47E-01

LogNormal

5.00

10.00

7.41E-01

2.22E-01

0.70

0.70

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

3.6E+01

LogNormal

0.70

Median Cost

Best Fit

CV or Beta

3.6E+01

LogNormal

0.70

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Not Given

By User

By User

Not Given

2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

D2061.024a

NISTIR Name
Description

Steam Piping - Large Diameter Welded Steel - (greater than 2.5 inches in diameter), SDC D, E, or F (OSHDP or sim), PIPING FRAGILITY
Costing based upon 1000 ft segments of pipe, pipe greater than 2.5 inches in diameter

Line 421

Construction Quality: Special Regulation (e.g. OSHPD) for Piping Installations
Seismic Installation Conditions: SDC D, E, F (high seismic design)

Fragility Unit of Measure:	LF 1000
Demand Parameter (unit):	Peak Floor Acceleration g
Number of Damage States:	2

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	Yes	

Damage State:	DS1	DS2			
Type of Damage State:	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Minor leakage at flange connections - 1 leak per 1000 feet of pipe. Pipe Break - 1 break per 1000 feet of pipe				

Illustrations

none	none			
1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	2.25	4.1			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO	Data Quality Marginal		Documentation Quality Marginal	
Directionality (Yes / No)	NO	Data Relevance Superior		Rationality Marginal	

Consequence Functions
Repair Description

Retighten flange bolts at leaking joints, 1 joint per 1000 LF.
Replace 20 foot sections of pipe where breaks occur, one per 1000 LF.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.50E+02	3.50E+02	8.00E+02	1.80E+03	3.35E+03	5.35E+03									
Best fit mean:	3.48E+02			3.21E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Cost (Min Qty, Max Qty)	7.00E+02 2.10E+02			6.70E+03 2.01E+03											
CV or beta (Min Qty, Max Qty)	0.65 0.65			0.40 0.40											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.59E-01	3.71E-01	8.47E-01	1.91E+00	3.55E+00	5.66E+00									
Best fit mean:	3.71E-01			3.55E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Time (Min Qty, Max Qty)	7.41E-01 2.22E-01			7.09E+00 2.13E+00											
CV or beta (Min Qty, Max Qty)	0.70 0.70			0.47 0.47											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	3.3E+01	LogNormal	0.70	4.8E+02	LogNormal	0.47									
Embodied Energy (MJ)	8.6E+02	LogNormal	0.70	1.2E+04	LogNormal	0.47									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			YES											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			10 SF											
Serious Injury (Median, Dispersion)	0% 0.00			5% 0.50											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments:
Date Created:
Approved (YES / NO)?
Official (YES / NO) ?
Author:
Revisions:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.
Not Given
By User
By User
Not Given
2016-10-26 - Corrected consequence descriptions.
Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D2061.024b

Steam Piping - Large Diameter Welded Steel - (greater than 2.5 inches in diameter), SDC D, E, or F (OSHPD or sim), BRACING FRAGILITY

Costing based upon 1000 ft segments of pipe, pipe greater than 2.5 inches in diameter

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Special Regulation (e.g. OSHPD) for Piping Installations

SDC D, E, F (high seismic design)

LF 1000

Peak Floor Acceleration

g

2

DS1

DS2

Sequential

Sequential

Seq(DS1,DS2)

Lateral Brace Failure - 1 failure per 1000 feet of pipe.

Vertical Brace Failure - 1 failure per 1000 feet of pipe

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

none

none

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

NO

NO

Data Quality

Marginal

Documentation Quality

Marginal

Rationality

Marginal

Consequence Functions

Repair Description

Replace failed supports, one per 1000 LF.

Replace failed supports, one per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.50E+02

3.50E+02

8.00E+02

LogNormal

5.00

10.00

7.00E+02

2.10E+02

0.65

0.65

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

1.50E+02

3.50E+02

8.00E+02

LogNormal

5.00

10.00

7.00E+02

2.10E+02

0.65

0.65

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.59E-01

3.71E-01

8.47E-01

LogNormal

5.00

10.00

7.41E-01

2.22E-01

0.70

0.70

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

1.59E-01

3.71E-01

8.47E-01

LogNormal

5.00

10.00

7.41E-01

2.22E-01

0.70

0.70

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

3.6E+01

LogNormal

0.70

Median Cost

Best Fit

CV or Beta

3.6E+01

LogNormal

0.70

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.

Not Given

By User

By User

Not Given

2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR ClassificationD3031.011a

NISTIR NameChiller - Capacity: < 100 Ton - Unanchored equipment that is not vibration isolated - Equipment fragility only

DescriptionCosting is per unit and is based upon 75 Ton.

Line 423

Construction Quality:Normal - Not designed for seismic loads

Seismic Installation Conditions:Unanchored equipment that is not vibration isolated

Quantity RoundingRound Qty?YES

Fragility Unit of Measure:TN 75

Allow sum by floor or building?BLDG

Demand Parameter (unit):Peak Floor Accelerationg

Demand Location (floor above?)No

Number of Damage States:1

Damage State:DS1

Type of Damage State:Sequential

DS HierarchySeq(DS1)

DescriptionsDamaged, inoperative.

Illustrations

none

1.00

Damage State Probability:1.00

Fragility Parameters

Median Demand, θ :0.2

Data dispersion, β_d :0.4

Uncertainty, β_u :0.1

Total Dispersion, β :0.4

Correlation (Yes / No)NO

Data Quality Average

Documentation Quality Superior

Directionality (Yes / No)NO

Data Relevance Average

Rationality Superior

Consequence Functions

Repair DescriptionRepair chiller and attached piping. Chiller removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.91E+04	4.62E+04	6.08E+04												
Best fit mean:	4.78E+04														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Cost (Min Qty, Max Qty)	5.08E+04		4.16E+04												
CV or beta (Min Qty, Max Qty)	0.18		0.18												
Quantity Unit:	Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.05E+00	9.51E+00	1.25E+01												
Best fit mean:	9.51E+00														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Time (Min Qty, Max Qty)	1.43E+01		4.76E+00												
CV or beta (Min Qty, Max Qty)	0.31		0.31												
Quantity Unit:	Each														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.6E+04	LogNormal	0.31												
Embodied Energy (MJ)	3.0E+05	LogNormal	0.31												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments:None

Date Created:Not Given

Approved (YES / NO)?By User

Official (YES / NO) ?By User

Author:Not Given

Revisions:2016-10-25 - Repair method clarified.

Root Cost Multiplier:1

Date Generated:02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.011b

Chiller - Capacity: 100 to <350 Ton - Unanchored equipment that is not vibration isolated - Equipment fragility only

Costing is per unit and is based upon 250 Ton.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Unanchored equipment that is not vibration isolated

TN 250

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

1.00

Damage State Probability:

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

0.2

0.4

0.1

0.4

Correlation (Yes / No)

NO

Data Quality

Average

Documentation Quality

Superior

Directionality (Yes / No)

NO

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair chiller and attached piping. Chiller removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.31E+05

1.53E+05

1.99E+05

1.58E+05

LogNormal

1.00

5.00

1.68E+05

1.38E+05

0.17

0.17

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

2.02E+01

2.36E+01

3.08E+01

2.36E+01

LogNormal

1.00

5.00

3.94E+01

1.18E+01

0.30

0.30

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO₂eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

8.5E+04

LogNormal

0.30

9.9E+05

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.011c

Chiller - Capacity: 350 to <750 Ton - Unanchored equipment that is not vibration isolated - Equipment fragility only

Costing is per unit and is based upon 500 Ton.

Line 425

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Unanchored equipment that is not vibration isolated

TN 500

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.2

0.4

0.1

0.4

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair chiller and attached piping. Chiller removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.17E+05

2.55E+05

3.33E+05

2.64E+05

LogNormal

1.00

5.00

2.81E+05

2.30E+05

0.17

0.17

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.24E+01

2.63E+01

3.42E+01

2.63E+01

LogNormal

1.00

5.00

5.25E+01

1.31E+01

0.30

0.30

Each

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

1.4E+05

LogNormal

0.30

1.6E+06

LogNormal

0.30

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.011d

Chiller - Capacity: 750 to <1000 Ton - Unanchored equipment that is not vibration isolated - Equipment fragility only

Costing is per unit and is based upon 850 Ton.

Line 426

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Unanchored equipment that is not vibration isolated

TN 850

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none				
1.00				

Fragility Parameters					
Median Demand, θ :	0.2				
Data dispersion, β_d :	0.4				
Uncertainty, β_u :	0.1				
Total Dispersion, β :	0.4				
Correlation (Yes / No)	NO		Data Quality Average		Documentation Quality Superior
Directionality (Yes / No)	NO		Data Relevance Average		Rationality Superior

Consequence Functions

Repair Description

Repair chiller and attached piping. Chiller removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No) YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.66E+05	4.31E+05	5.62E+05												
Best fit mean:	4.45E+05														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Cost (Min Qty, Max Qty)	4.74E+05		3.88E+05												
CV or beta (Min Qty, Max Qty)	0.17		0.17												
Quantity Unit:	Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.63E+01	3.11E+01	4.05E+01												
Best fit mean:	3.11E+01														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Time (Min Qty, Max Qty)	7.54E+01		1.55E+01												
CV or beta (Min Qty, Max Qty)	0.30		0.30												
Quantity Unit:	Each														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.4E+05	LogNormal	0.30												
Embodied Energy (MJ)	2.8E+06	LogNormal	0.30												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

D3031.012a

NISTIR Name
Description

Chiller - Capacity: < 100 Ton - Vibration isolated equipment that is not snubbed or restrained - Anchorage fragility only
Costing is per unit and is based upon 75 Ton.

Line 427

Construction Quality:

Normal - Not designed for seismic loads

Seismic Installation Conditions: Vibration isolated equipment that is not snubbed or restrained

Fragility Unit of Measure: TN 75

Demand Parameter (unit): Peak Floor Acceleration g

Number of Damage States: 2

Damage State:

DS1

DS2

Type of Damage State:

Mutually Exclusive

Mutually Exclusive

DS Hierarchy: MutEx(DS1.DS2)

Descriptions

Anchorage failure.

Anchorage failure & Equipment
damaged beyond repair.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?	BLDG	
Demand Location (floor above?)	No	

Illustrations

none	none			
0.70	0.30			

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

By User
User to Calculate
User to Calculate
By User

By User
User to Calculate
User to Calculate
By User

Data Quality Average

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and
remount equipment.

Replace equipment including attached utilities
in addition to repairing anchorage and
concrete pad. Chiller removed, repaired
offsite, and reinstalled.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	5.00E+02	1.00E+03	1.70E+03	3.96E+04	4.72E+04	6.25E+04									
Best fit mean:	9.59E+02			4.88E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Cost (Min Qty, Max Qty)	2.00E+03		6.00E+02	9.44E+04		2.83E+04									
CV or beta (Min Qty, Max Qty)	0.45		0.45	0.18		0.18									
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.15E-01	1.03E+00	1.75E+00	8.15E+00	9.72E+00	1.29E+01									
Best fit mean:	1.03E+00			9.72E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Time (Min Qty, Max Qty)	2.06E+00		6.18E-01	5.83E+01		4.86E+00									
CV or beta (Min Qty, Max Qty)	0.52		0.52	0.31		0.31									
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.1E+02	LogNormal	0.52	2.6E+04	LogNormal	0.31									
Embodied Energy (MJ)	3.2E+03	LogNormal	0.52	3.0E+05	LogNormal	0.31									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										

Comments:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Date Created:

Not Given

Root Cost Multiplier: 1

Approved (YES / NO)?

By User

Date Generated: 02/26/19

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2016-10-25 - Repair method clarified.

FEMA P-58 Fragility Specification

NISTIR Classification

D3031.012b

NISTIR Name
Description

Chiller - Capacity: < 100 Ton - Vibration isolated equipment that is not snubbed or restrained - Equipment fragility only
Costing is per unit and is based upon 75 Ton.

Line 428

Construction Quality:

Normal - Not designed for seismic loads

Seismic Installation Conditions:

Vibration isolated equipment that is not snubbed or restrained

Fragility Unit of Measure:

TN 75

Demand Parameter (unit):

Peak Floor Acceleration g

Number of Damage States:

1

Damage State:

DS1

Type of Damage State:

Sequential

DS Hierarchy

Seq(DS1)

Descriptions

Damaged, inoperative but anchorage is OK.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?	BLDG	
Demand Location (floor above?)	No	

Illustrations

none				
1.00				

Damage State Probability:

Fragility Parameters

Median Demand, θ :

0.43

Data dispersion, β_d :

0.6

Uncertainty, β_u :

0.1

Total Dispersion, β :

0.6

Correlation (Yes / No)

NO

Directionality (Yes / No)

NO

Data Quality Average

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Consequence Functions

Repair Description

Repair chiller and attached piping. Chiller removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.91E+04	4.62E+04	6.08E+04												
Best fit mean:	4.78E+04														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Cost (Min Qty, Max Qty)	5.08E+04		4.16E+04												
CV or beta (Min Qty, Max Qty)	0.18		0.18												
Quantity Unit:	Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.05E+00	9.51E+00	1.25E+01												
Best fit mean:	9.51E+00														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Time (Min Qty, Max Qty)	1.43E+01		4.76E+00												
CV or beta (Min Qty, Max Qty)	0.31		0.31												
Quantity Unit:	Each														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.6E+04	LogNormal	0.31												
Embodied Energy (MJ)	3.0E+05	LogNormal	0.31												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2016-10-25 - Repair method clarified.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.012c

Chiller - Capacity: < 100 Ton - Vibration isolated equipment that is not snubbed or restrained - Combined anchorage/isolator & equipment fragility

Costing is per unit and is based upon 75 Ton.

Line 429

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

TN 75

Peak Floor Acceleration

g

3

DS1

DS2

DS3

Mutually Exclusive

Mutually Exclusive

Mutually Exclusive

MutEx(DS1,DS2,DS3)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Damaged, Inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.35

0.15

0.50

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

NO

Data Quality

Average

Documentation Quality

Superior

NO

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Chiller removed, repaired offsite, and reinstalled.

Repair chiller and attached piping. Chiller removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

NO

YES

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	5.00E+02	1.00E+03	1.70E+03	3.96E+04	4.72E+04	6.25E+04	3.96E+04	4.72E+04	6.25E+04						
Best fit mean:	9.59E+02			4.88E+04			4.88E+04								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00						
Average Repair Cost (Min Qty, Max Qty)	1.10E+03		9.00E+02	5.19E+04		4.25E+04	5.19E+04		4.25E+04						
CV or beta (Min Qty, Max Qty)	0.45		0.45	0.18		0.18	0.18		0.18						
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.15E-01	1.03E+00	1.75E+00	8.15E+00	9.72E+00	1.29E+01	8.15E+00	9.72E+00	1.29E+01						
Best fit mean:	1.03E+00			9.72E+00			9.72E+00								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00						
Average Repair Time (Min Qty, Max Qty)	1.13E+00		9.26E-01	1.46E+01		4.86E+00	1.46E+01		4.86E+00						
CV or beta (Min Qty, Max Qty)	0.52		0.52	0.31		0.31	0.31		0.31						
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.1E+02	LogNormal	0.52	2.6E+04	LogNormal	0.31	2.6E+04	LogNormal	0.31						
Embodied Energy (MJ)	3.2E+03	LogNormal	0.52	3.0E+05	LogNormal	0.31	3.0E+05	LogNormal	0.31						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			NO								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

Date Generated:

02/26/19

Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.		
Date Created:	Not Given	Root Cost Multiplier:	1
Approved (YES / NO)?	By User	Date Generated:	02/26/19
Official (YES / NO) ?	By User		
Author:	Not Given		
Revisions:	2016-10-25 - Repair method clarified.		

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.012e

Chiller - Capacity: 100 to <350 Ton - Vibration isolated equipment that is not snubbed or restrained - Equipment fragility only

Costing is per unit and is based upon 250 Ton.

Line 431

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

TN 250

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.43

0.6

0.1

0.6

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair chiller and attached piping. Chiller removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.31E+05

1.53E+05

1.99E+05

1.58E+05

LogNormal

1.00

5.00

1.68E+05

1.38E+05

0.17

0.17

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.02E+01

2.36E+01

3.08E+01

2.36E+01

LogNormal

1.00

5.00

3.94E+01

1.18E+01

0.30

0.30

Each

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

8.5E+04

LogNormal

0.30

9.9E+05

LogNormal

0.30

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

Date Generated:

02/26/19

Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.		
Date Created:	Not Given	Root Cost Multiplier:	1
Approved (YES / NO)?	By User	Date Generated:	02/26/19
Official (YES / NO) ?	By User		
Author:	Not Given		
Revisions:	2016-10-25 - Repair method clarified.		

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.012g

Chiller - Capacity: 350 to <750 Ton - Vibration isolated equipment that is not snubbed or restrained - Anchorage fragility only

Costing is per unit and is based upon 500 Ton.

Line 433

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

TN 500

Peak Floor Acceleration

2

DS1

Mutually Exclusive

MutEx(DS1.DS2)

Anchorage failure.

DS2

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

none

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.70

0.30

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Chiller removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES

YES

Repair Costs:

Repair Time:

Environmental Impacts:

LifeSafety Hazard:

P₁₀

P₅₀

P₉₀

1.40E+03

2.20E+03

3.10E+03

P₁₀

P₅₀

P₉₀

2.19E+05

2.57E+05

3.36E+05

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.23E+03

Normal

1.00

5.00

2.66E+05

LogNormal

1.00

5.00

4.40E+03

1.32E+03

5.15E+05

1.54E+05

0.30

0.30

0.17

0.17

Each

Each

P₁₀

P₅₀

P₉₀

1.44E+00

2.26E+00

3.19E+00

P₁₀

P₅₀

P₉₀

2.25E+01

2.65E+01

3.46E+01

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.26E+00

Normal

1.00

5.00

2.65E+01

LogNormal

1.00

5.00

4.53E+00

1.36E+00

2.91E+02

1.32E+01

0.39

0.39

0.30

0.30

Each

Each

Median Cost

Best Fit

CV or Beta

2.5E+02

Normal

0.39

Median Cost

Best Fit

CV or Beta

1.4E+05

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

7.4E+03

Normal

0.39

1.7E+06

LogNormal

0.30

Potential non-collapse casualties? (Yes / No)

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

NO

NO

0%

0.00

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.012h

Chiller - Capacity: 350 to <750 Ton - Vibration isolated equipment that is not snubbed or restrained - Equipment fragility only

Costing is per unit and is based upon 500 Ton.

Line 434

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

TN 500

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

Damage State Probability:

1.00

none

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

NO

NO

Data Quality Average

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Consequence Functions

Repair Description

Repair chiller and attached piping. Chiller removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.17E+05	2.55E+05	3.33E+05												
Best fit mean:	2.64E+05														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Cost (Min Qty, Max Qty)	2.81E+05		2.30E+05												
CV or beta (Min Qty, Max Qty)	0.17		0.17												
Quantity Unit:	Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.24E+01	2.63E+01	3.42E+01												
Best fit mean:	2.63E+01														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Time (Min Qty, Max Qty)	5.25E+01		1.31E+01												
CV or beta (Min Qty, Max Qty)	0.30		0.30												
Quantity Unit:	Each														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.4E+05	LogNormal	0.30												
Embodied Energy (MJ)	1.6E+06	LogNormal	0.30												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.012i

Chiller - Capacity: 350 to <750 Ton - Vibration isolated equipment that is not snubbed or restrained - Combined anchorage/isolator & equipment fragility

Costing is per unit and is based upon 500 Ton.

Line 435

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

TN 500

Peak Floor Acceleration

g

3

DS1

DS2

DS3

Mutually Exclusive

Mutually Exclusive

Mutually Exclusive

MutEx(DS1,DS2,DS3)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.35

0.15

0.50

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Chiller removed, repaired offsite, and reinstalled.

Repair chiller and attached piping. Chiller removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES

YES

YES

Repair Costs:

Repair Time:

Environmental Impacts:

LifeSafety Hazard:

P₁₀

P₅₀

P₉₀

1.40E+03

2.20E+03

3.10E+03

P₁₀

P₅₀

P₉₀

2.19E+05

2.57E+05

3.36E+05

P₁₀

P₅₀

P₉₀

2.19E+05

2.57E+05

3.36E+05

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

2.23E+03

Normal

1.00

5.00

2.42E+03

1.98E+03

0.30

0.30

Each

2.66E+05

LogNormal

1.00

5.00

2.83E+05

2.32E+05

0.17

0.17

Each

2.66E+05

LogNormal

1.00

5.00

2.83E+05

2.32E+05

0.17

0.17

Each

P₁₀

P₅₀

P₉₀

1.44E+00

2.26E+00

3.19E+00

P₁₀

P₅₀

P₉₀

2.25E+01

2.65E+01

3.46E+01

P₁₀

P₅₀

P₉₀

2.25E+01

2.65E+01

3.46E+01

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

2.26E+00

Normal

1.00

5.00

2.49E+00

2.04E+00

0.39

0.39

Each

2.65E+01

LogNormal

1.00

5.00

5.30E+01

1.32E+01

0.30

0.30

Each

2.65E+01

LogNormal

1.00

5.00

5.30E+01

1.32E+01

0.30

0.30

Each

Median Cost

Best Fit

CV or Beta

2.5E+02

Normal

0.39

Median Cost

Best Fit

CV or Beta

1.4E+05

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

1.4E+05

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

2.5E+02

Normal

0.39

1.4E+05

LogNormal

0.30

1.4E+05

LogNormal

0.30

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

D3031.012j

NISTIR Name

Chiller - Capacity: 750 to <1000 Ton - Vibration isolated equipment that is not snubbed or restrained - Anchorage fragility only

Description

Costing is per unit and is based upon 850 Ton.

Line 436

Construction Quality:

Normal - Not designed for seismic loads

Seismic Installation Conditions:

Vibration isolated equipment that is not snubbed or restrained

Fragility Unit of Measure:

TN 850

Demand Parameter (unit):

Peak Floor Acceleration g

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Mutually Exclusive

Mutually Exclusive

DS Hierarchy

MutEx(DS1.DS2)

Descriptions

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?	BLDG	
Demand Location (floor above?)	No	

Illustrations

none	none			
0.70	0.30			

Damage State Probability:

Fragility Parameters

Median Demand, θ :

By User

By User

Data dispersion, β_d :

User to Calculate

User to Calculate

Uncertainty, β_u :

User to Calculate

User to Calculate

Total Dispersion, β :

By User

By User

Correlation (Yes / No)

NO

Data Quality Average

Documentation Quality Superior

Directionality (Yes / No)

NO

Data Relevance Average

Rationality Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Chiller removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES

YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.60E+03	2.40E+03	3.40E+03	3.67E+05	4.33E+05	5.65E+05									
Best fit mean:	2.36E+03			4.48E+05											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00			5.00											
Average Repair Cost (Min Qty, Max Qty)	4.80E+03			1.44E+03			8.67E+05			2.60E+05					
CV or beta (Min Qty, Max Qty)	0.29			0.29			0.17			0.17					
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.65E+00	2.47E+00	3.50E+00	2.65E+01	3.12E+01	4.07E+01									
Best fit mean:	2.47E+00			3.12E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00			5.00			1.00			5.00					
Average Repair Time (Min Qty, Max Qty)	4.94E+00			1.48E+00			4.77E+02			1.56E+01					
CV or beta (Min Qty, Max Qty)	0.38			0.38			0.30			0.30					
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.5E+02	LogNormal	0.38	2.4E+05	LogNormal	0.30									
Embodied Energy (MJ)	7.4E+03	LogNormal	0.38	2.8E+06	LogNormal	0.30									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										

Comments:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Date Created:

Not Given

Root Cost Multiplier: 1

Approved (YES / NO)?

By User

Date Generated: 02/26/19

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2016-10-25 - Repair method clarified.

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.012k

Chiller - Capacity: 750 to <1000 Ton - Vibration isolated equipment that is not snubbed or restrained - Equipment fragility only

Costing is per unit and is based upon 850 Ton.

Line 437

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

TN 850

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.43

0.6

0.1

0.6

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair chiller and attached piping. Chiller removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

3.66E+05

4.31E+05

5.62E+05

4.45E+05

LogNormal

1.00

5.00

4.74E+05

3.88E+05

0.17

0.17

Each

P₁₀

P₅₀

P₉₀

2.63E+01

3.11E+01

4.05E+01

3.11E+01

LogNormal

1.00

5.00

7.54E+01

1.55E+01

0.30

0.30

Each

Median Cost

Best Fit

CV or Beta

2.4E+05

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

2.8E+06

LogNormal

0.30

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.012I

Chiller - Capacity: 750 to <1000 Ton - Vibration isolated equipment that is not snubbed or restrained - Combined anchorage/isolator & equipment fragility

Costing is per unit and is based upon 850 Ton.

Line 438

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

TN 850

Peak Floor Acceleration

3

DS1

Mutually Exclusive

MutEx(DS1,DS2,DS3)

Anchorage failure.

DS2

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

DS3

Mutually Exclusive

Damaged, Inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

0.35

none

0.15

none

0.50

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

User to Calculate

By User

NO

Data Quality

Average

Documentation Quality

Superior

NO

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Chiller removed, repaired offsite, and reinstalled.

Repair chiller and attached piping. Chiller removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES

YES

YES

Repair Costs:

Repair Time:

Environmental Impacts:

LifeSafety Hazard:

P₁₀

P₅₀

P₉₀

1.60E+03

2.40E+03

3.40E+03

P₁₀

P₅₀

P₉₀

3.67E+05

4.33E+05

5.65E+05

P₁₀

P₅₀

P₉₀

3.67E+05

4.33E+05

5.65E+05

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

2.36E+03

LogNormal

1.00

5.00

0.29

Each

P₁₀

P₅₀

P₉₀

2.47E+00

LogNormal

1.00

5.00

0.29

Each

P₁₀

P₅₀

P₉₀

3.12E+01

LogNormal

1.00

5.00

0.30

Each

P₁₀

P₅₀

P₉₀

3.12E+01

LogNormal

1.00

5.00

0.30

Each

Median Cost

Best Fit

CV or Beta

2.5E+02

LogNormal

0.38

Median Cost

Best Fit

CV or Beta

2.4E+05

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

2.4E+05

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

2.5E+02

LogNormal

0.38

7.4E+03

LogNormal

0.38

2.4E+05

LogNormal

0.30

2.8E+06

LogNormal

0.30

2.4E+05

LogNormal

0.30

2.8E+06

LogNormal

0.30

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.013a

Chiller - Capacity: < 100 Ton - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragility only

Costing is per unit and is based upon 75 Ton.

Line 439

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

TN 75

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

MutEx(DS1.DS2)

Anchorage failure.

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D3031.013a-DS1-1.JPG

none

0.30

0.70

0.30

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

By User

User to Calculate

User to Calculate

By User

NO

NO

Data Quality

Average

Data Relevance

Average

Documentation Quality

Superior

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Chiller removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

5.00E+02

1.00E+03

1.70E+03

3.96E+04

4.72E+04

6.25E+04

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

5.15E-01

1.03E+00

1.75E+00

8.15E+00

9.72E+00

1.29E+01

Environmental Impacts:

Embodied Carbon (kg CO₂eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

1.1E+02

LogNormal

0.52

2.6E+04

LogNormal

0.31

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.013b

Chiller - Capacity: < 100 Ton - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragility only

Costing is per unit and is based upon 75 Ton.

Line 440

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

TN 75

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D3031.013a-DS1-1.JPG

1.00

Damage State Probability:

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.72

0.2

0.1

0.2

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair chiller and attached piping. Chiller removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

3.91E+04

4.62E+04

6.08E+04

4.78E+04

LogNormal

1.00

5.00

5.08E+04

4.16E+04

0.18

0.18

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

8.05E+00

9.51E+00

1.25E+01

9.51E+00

LogNormal

1.00

5.00

1.43E+01

4.76E+00

0.31

0.31

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

2.6E+04

LogNormal

0.31

3.0E+05

LogNormal

0.31

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.013c

Chiller - Capacity: < 100 Ton - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage/isolator & equipment

Costing is per unit and is based upon 75 Ton.

Line 441

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

TN 75

Peak Floor Acceleration

g

3

DS1

Mutually Exclusive

MutEx(DS1,DS2,DS3)

Anchorage failure.

DS2

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

DS3

Mutually Exclusive

Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D3031.013a-DS1-1.JPG

none

0.35

none

0.15

none

0.50

Damage State Probability:

0.35

0.15

0.50

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

By User

User to Calculate

User to Calculate

By User

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Chiller removed, repaired offsite, and reinstalled.

Repair chiller and attached piping. Chiller removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

NO

YES

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

5.00E+02

1.00E+03

1.70E+03

LogNormal

1.00

5.00

1.10E+03

9.00E+02

0.45

0.45

Each

P₁₀

P₅₀

P₉₀

3.96E+04

4.72E+04

6.25E+04

LogNormal

1.00

5.00

5.19E+04

4.25E+04

0.18

0.18

Each

P₁₀

P₅₀

P₉₀

3.96E+04

4.72E+04

6.25E+04

LogNormal

1.00

5.00

5.19E+04

4.25E+04

0.18

0.18

Each

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

5.88E-01

1.18E+00

2.00E+00

LogNormal

1.00

5.00

1.29E+00

1.06E+00

0.52

0.52

Each

P₁₀

P₅₀

P₉₀

4.66E+00

5.55E+00

7.35E+00

LogNormal

1.00

5.00

1.11E+01

2.78E+00

0.31

0.31

Each

P₁₀

P₅₀

P₉₀

9.32E+00

1.11E+01

1.47E+01

LogNormal

1.00

5.00

1.67E+01

5.55E+00

0.31

0.31

Each

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

1.1E+02

LogNormal

0.52

Median Cost

Best Fit

CV or Beta

2.6E+04

LogNormal

0.31

Median Cost

Best Fit

CV or Beta

2.6E+04

LogNormal

0.31

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

NO

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

NO

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

NO

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

Date Generated:

02/26/19

Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.		
Date Created:	Not Given	Root Cost Multiplier:	1
Approved (YES / NO)?	By User	Date Generated:	02/26/19
Official (YES / NO) ?	By User		
Author:	Not Given		
Revisions:	2016-10-25 - Repair method clarified.		

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.013e

Chiller - Capacity: 100 to <350 Ton - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragility only

Line 443

Costing is per unit and is based upon 250 Ton.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative but anchorage is OK.

Illustrations

D3031.013a-DS1-1.JPG

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Data Quality Average

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Consequence Functions

Repair Description

Repair chiller and attached piping. Chiller removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.02E+01

2.36E+01

3.08E+01

1.31E+05

1.53E+05

1.99E+05

1.58E+05

LogNormal

1.00

5.00

1.68E+05

1.38E+05

0.17

0.17

Each

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.02E+01

2.36E+01

3.08E+01

2.36E+01

LogNormal

1.00

5.00

3.94E+01

1.18E+01

0.30

0.30

Each

Environmental Impacts:

Embodied Carbon (kg CO₂eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

8.5E+04

LogNormal

0.30

9.9E+05

LogNormal

0.30

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier: 1

Date Generated: 02/26/19

Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.		
Date Created:	Not Given	Root Cost Multiplier:	1
Approved (YES / NO)?	By User	Date Generated:	02/26/19
Official (YES / NO) ?	By User		
Author:	Not Given		
Revisions:	2016-10-25 - Repair method clarified.		

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.013g

Chiller - Capacity: 350 to <750 Ton - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragility only

Costing is per unit and is based upon 500 Ton.

Line 445

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

TN 500

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

Mutually Exclusive

MutEx(DS1.DS2)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES


Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations



D3031.013a-DS1-1.JPG

none

0.30

Damage State Probability:

0.70

0.30

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Chiller removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES

YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.40E+03	2.20E+03	3.10E+03	2.19E+05	2.57E+05	3.36E+05									
Best fit mean:	2.23E+03			2.66E+05											
Best Fit Distribution:	Normal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Cost (Min Qty, Max Qty)	2.42E+03		1.98E+03	2.83E+05		2.32E+05									
CV or beta (Min Qty, Max Qty)	0.30		0.30	0.17		0.17									
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.44E+00	2.26E+00	3.19E+00	2.25E+01	2.65E+01	3.46E+01									
Best fit mean:	2.26E+00			2.65E+01											
Best Fit Distribution:	Normal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Time (Min Qty, Max Qty)	2.49E+00		2.04E+00	5.30E+01		1.32E+01									
CV or beta (Min Qty, Max Qty)	0.39		0.39	0.30		0.30									
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.5E+02	Normal	0.39	1.4E+05	LogNormal	0.30									
Embodied Energy (MJ)	7.4E+03	Normal	0.39	1.7E+06	LogNormal	0.30									
LifeSafety Hazard:	Potential non-collapse casualties? (Yes / No)	NO		Potential non-collapse casualties? (Yes / No)	NO										
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.013h

Chiller - Capacity: 350 to <750 Ton - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragility only

Costing is per unit and is based upon 500 Ton.

Line 446

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

TN 500

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D3031.013a-DS1-1.JPG

1.00

0.72

0.2

0.1

0.2

NO

NO

Correlation (Yes / No)

Directionality (Yes / No)

NO

NO

Data Quality Average

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Consequence Functions

Repair Description

Repair chiller and attached piping. Chiller removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

2.17E+05

2.55E+05

3.33E+05

2.64E+05

LogNormal

1.00

5.00

2.81E+05

2.30E+05

0.17

0.17

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

2.56E+01

3.00E+01

3.91E+01

3.00E+01

LogNormal

1.00

5.00

6.00E+01

1.50E+01

0.30

0.30

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO₂eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

1.4E+05

LogNormal

0.30

1.6E+06

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.013i

Chiller - Capacity: 350 to <750 Ton - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage/isolator & eq

Costing is per unit and is based upon 500 Ton.

Line 447

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

TN 500

Peak Floor Acceleration

g

3

DS1

DS2

DS3

Mutually Exclusive

Mutually Exclusive

Mutually Exclusive

MutEx(DS1.DS2.DS3)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Damaged, Inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D3031.013a-DS1-1.JPG

0.35

none

0.15

none

0.50

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

By User

User to Calculate

User to Calculate

By User

NO

NO

Data Quality

Average

Data Relevance

Average

Documentation Quality

Superior

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Chiller removed, repaired offsite, and reinstalled.

Repair chiller and attached piping. Chiller removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES

YES

YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.40E+03	2.20E+03	3.10E+03	2.19E+05	2.57E+05	3.36E+05	2.19E+05	2.57E+05	3.36E+05						
Best fit mean:	2.23E+03			2.66E+05			2.66E+05								
Best Fit Distribution:	Normal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00						
Average Repair Cost (Min Qty, Max Qty)	2.42E+03		1.98E+03	2.83E+05		2.32E+05	2.83E+05		2.32E+05						
CV or beta (Min Qty, Max Qty)	0.30		0.30	0.17		0.17	0.17		0.17						
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.65E-01	2.59E-01	3.65E-01	2.57E+01	3.03E+01	3.95E+01	2.57E+01	3.03E+01	3.95E+01						
Best fit mean:	2.59E-01			3.03E+01			3.03E+01								
Best Fit Distribution:	Normal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00						
Average Repair Time (Min Qty, Max Qty)	2.85E-01		2.33E-01	3.33E+01		2.73E+01	3.33E+01		2.73E+01						
CV or beta (Min Qty, Max Qty)	0.39		0.39	0.30		0.30	0.30		0.30						
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.5E+02	Normal	0.39	1.4E+05	LogNormal	0.30	1.4E+05	LogNormal	0.30						
Embodied Energy (MJ)	7.4E+03	Normal	0.39	1.7E+06	LogNormal	0.30	1.7E+06	LogNormal	0.30						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			NO								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.013j

Chiller - Capacity: 750 to <1000 Ton - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragility only

Costing is per unit and is based upon 850 Ton.

Line 448

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

TN 850

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

Mutually Exclusive

MutEx(DS1.DS2)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D3031.013a-DS1-1.JPG

none

0.30

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

Damage State Probability:

Correlation (Yes / No)

Directionality (Yes / No)

Consequence Functions

Repair Description

0.70

NO

NO

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Chiller removed, repaired offsite, and reinstalled.

Data Quality Average

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Long Lead Time (Yes / No)

YES

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.60E+03

2.40E+03

3.40E+03

2.36E+03

LogNormal

1.00

5.00

2.64E+03

2.16E+03

0.29

0.29

Each

P₁₀

P₅₀

P₉₀

3.67E+05

4.33E+05

5.65E+05

4.48E+05

LogNormal

1.00

5.00

4.77E+05

3.90E+05

0.17

0.17

Each

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.65E+00

2.47E+00

3.50E+00

2.47E+00

LogNormal

1.00

5.00

2.72E+00

2.22E+00

0.38

0.38

Each

P₁₀

P₅₀

P₉₀

2.65E+01

3.12E+01

4.07E+01

3.12E+01

LogNormal

1.00

5.00

7.58E+01

1.56E+01

0.30

0.30

Each

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

2.5E+02

LogNormal

0.38

2.4E+05

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

2.8E+06

LogNormal

0.30

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.013k

Chiller - Capacity: 750 to <1000 Ton - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragility only

Line 449

Costing is per unit and is based upon 850 Ton.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative but anchorage is OK.

Illustrations

D3031.013a-DS1-1.JPG

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

NO

NO

Data Quality Average

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Consequence Functions

Repair Description

Repair chiller and attached piping. Chiller removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

3.66E+05

4.31E+05

5.62E+05

4.45E+05

LogNormal

1.00

5.00

4.74E+05

3.88E+05

0.17

0.17

Each

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

3.01E+01

3.55E+01

4.63E+01

3.55E+01

LogNormal

1.00

5.00

8.62E+01

1.77E+01

0.30

0.30

Each

Environmental Impacts:

Embodied Carbon (kg CO₂eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

2.4E+05

LogNormal

0.30

2.8E+06

LogNormal

0.30

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description


D3031.013I

Chiller - Capacity: 750 to <1000 Ton - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage/isolator & e

Costing is per unit and is based upon 850 Ton.

Line 450

Construction Quality:	Normal - Designed for seismic loads but no special seismic certification			
Seismic Installation Conditions:	Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints			
Fragility Unit of Measure:	TN 850			
Demand Parameter (unit):	Peak Floor Acceleration g			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Mutually Exclusive		Mutually Exclusive	
DS Hierarchy	MutEx(DS1,DS2,DS3)		Mutually Exclusive	
Descriptions	Anchorage failure.	Anchorage failure & Equipment damaged beyond repair.	Damaged, Inoperative but anchorage is OK.	

Illustrations						
	D3031.013a-DS1-1.JPG				none	none
	0.35				0.15	0.50
Damage State Probability:						
Fragility Parameters						
Median Demand, θ :	By User					
Data dispersion, β_d :	User to Calculate					
Uncertainty, β_u :	User to Calculate					
Total Dispersion, β :	By User					
Correlation (Yes / No)	NO				Data Quality Average	Documentation Quality Superior
Directionality (Yes / No)	NO				Data Relevance Average	Rationality Superior
Consequence Functions						
Repair Description	Repair anchorage and concrete pad and remount equipment.				Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Chiller removed, repaired offsite, and reinstalled.	Repair chiller and attached piping. Chiller removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)	YES			YES			YES					
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.60E+03	2.40E+03	3.40E+03	3.67E+05	4.33E+05	5.65E+05	3.67E+05	4.33E+05	5.65E+05			
Best fit mean:	2.36E+03			4.48E+05			4.48E+05					
Best Fit Distribution:	LogNormal			LogNormal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00			
Average Repair Cost (Min Qty, Max Qty)	2.64E+03		2.16E+03	4.77E+05		3.90E+05	4.77E+05		3.90E+05			
CV or beta (Min Qty, Max Qty)	0.29		0.29	0.17		0.17	0.17		0.17			
Quantity Unit:	Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.88E-01	2.82E-01	4.00E-01	3.02E+00	3.57E+00	4.65E+00	3.02E+00	3.57E+00	4.65E+00			
Best fit mean:	2.82E-01			3.57E+00			3.57E+00					
Best Fit Distribution:	LogNormal			LogNormal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00			
Average Repair Time (Min Qty, Max Qty)	3.11E-01		2.54E-01	8.67E+00		1.78E+00	8.67E+00		1.78E+00			
CV or beta (Min Qty, Max Qty)	0.38		0.38	0.30		0.30	0.30		0.30			
Quantity Unit:	Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.5E+02	LogNormal	0.38	2.4E+05	LogNormal	0.30	2.4E+05	LogNormal	0.30			
Embodied Energy (MJ)	7.4E+03	LogNormal	0.38	2.8E+06	LogNormal	0.30	2.8E+06	LogNormal	0.30			
LifeSafety Hazard:												
Potential non-collapse casualties? (Yes / No)	NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00				
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00				
Post-event Tagging Flag:	NO			NO			NO					
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00				

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.021a

Cooling Tower - Capacity: < 100 Ton - Unanchored equipment that is not vibration isolated - Equipment fragility only

Costing is per unit and is based upon 75 Ton.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Unanchored equipment that is not vibration isolated

TN 75

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Damaged equipment and attached piping.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

1.00

Damage State Probability:

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

0.5

0.4

0.1

0.4

Correlation (Yes / No)

NO

Data Quality

Average

Documentation Quality

Superior

Directionality (Yes / No)

NO

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair damaged equipment and attached piping. Cooling tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

2.01E+04

2.37E+04

3.08E+04

2.45E+04

LogNormal

1.00

5.00

2.61E+04

2.13E+04

0.17

0.17

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

4.73E+00

5.58E+00

7.25E+00

5.58E+00

LogNormal

1.00

5.00

8.36E+00

2.79E+00

0.30

0.30

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

1.3E+04

LogNormal

0.30

1.5E+05

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.021b

Cooling Tower - Capacity: 100 to <350 Ton - Unanchored equipment that is not vibration isolated - Equipment fragility only

Costing is per unit and is based upon 250 Ton.

Line 452

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Unanchored equipment that is not vibration isolated

TN 250

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Damaged equipment and attached piping.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.5

0.4

0.1

0.4

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair damaged equipment and attached piping. Cooling tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

6.65E+04

7.80E+04

1.02E+05

8.09E+04

LogNormal

1.00

5.00

8.58E+04

7.02E+04

0.17

0.17

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.17E+01

1.38E+01

1.81E+01

1.38E+01

LogNormal

1.00

5.00

2.29E+01

6.88E+00

0.30

0.30

Each

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

4.3E+04

LogNormal

0.30

5.0E+05

LogNormal

0.30

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.021c

Cooling Tower - Capacity: 350 to <750 Ton - Unanchored equipment that is not vibration isolated - Equipment fragility only

Costing is per unit and is based upon 500 Ton.

Line 453

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Unanchored equipment that is not vibration isolated

TN 500

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

Damaged equipment and attached piping.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.5

0.4

0.1

0.4

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair damaged equipment and attached piping. Cooling tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES

Repair Costs:

Repair Time:

Environmental Impacts:

LifeSafety Hazard:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.10E+05

1.30E+05

1.71E+05

1.35E+05

LogNormal

1.00

5.00

1.43E+05

1.17E+05

0.18

0.18

Each

1.30E+01

1.53E+01

2.01E+01

1.53E+01

LogNormal

1.00

5.00

3.06E+01

7.66E+00

0.31

0.31

Each

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

7.2E+04

LogNormal

0.31

8.4E+05

LogNormal

0.31

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.021d

Cooling Tower - Capacity: 750 to <1000 Ton - Unanchored equipment that is not vibration isolated - Equipment fragility only

Costing is per unit and is based upon 850 Ton.

Line 454

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Unanchored equipment that is not vibration isolated

TN 850

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Damaged equipment and attached piping.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.5

0.4

0.1

0.4

NO

NO

Data Quality Average

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Consequence Functions

Repair Description

Repair damaged equipment and attached piping. Cooling tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES

Repair Costs:

Repair Time:

Environmental Impacts:

LifeSafety Hazard:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

1.86E+05

2.19E+05

2.85E+05

2.26E+05

LogNormal

1.00

5.00

2.40E+05

1.97E+05

0.17

0.17

Each

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

1.53E+01

1.80E+01

2.35E+01

1.80E+01

LogNormal

1.00

5.00

4.37E+01

9.00E+00

0.30

0.30

Each

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

1.2E+05

LogNormal

0.30

1.4E+06

LogNormal

0.30

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.022a

Cooling Tower - Capacity: < 100 Ton - Vibration isolated equipment that is not snubbed or restrained - Anchorage fragility only

Costing is per unit and is based upon 75 Ton.

Line 455

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

TN 75

Peak Floor Acceleration

2

DS1

Mutually Exclusive

MutEx(DS1.DS2)

Anchorage failure.

DS2

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

none

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.70

0.30

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Cooling tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Time:

Environmental Impacts:

LifeSafety Hazard:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

5.00E+02

1.00E+03

1.70E+03

2.06E+04

2.47E+04

3.25E+04

1.95E+02

9.59E+02

LogNormal

1.00

5.00

1.10E+03

9.00E+02

2.72E+04

2.22E+04

0.45

0.45

0.18

0.18

Each

Each

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

5.88E-02

1.18E-01

2.00E-01

2.42E+00

2.91E+00

3.82E+00

1.18E-01

LogNormal

1.00

5.00

1.29E-01

1.06E-01

3.20E+00

2.62E+00

0.52

0.52

0.31

0.31

Each

Each

Median Cost

Best Fit

CV or Beta

1.1E+02

LogNormal

0.52

1.3E+04

LogNormal

0.31

3.2E+03

LogNormal

0.52

1.5E+05

LogNormal

0.31

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.022b

Cooling Tower - Capacity: < 100 Ton - Vibration isolated equipment that is not snubbed or restrained - Equipment fragility only

Costing is per unit and is based upon 75 Ton.

Line 456

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

TN 75

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Damaged equipment and attached piping but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.97

0.6

0.1

0.6

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair damaged equipment and attached piping. Cooling tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Time:

Environmental Impacts:

LifeSafety Hazard:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

2.01E+04

2.37E+04

3.08E+04

2.45E+04

LogNormal

1.00

5.00

2.61E+04

2.13E+04

0.17

0.17

Each

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

4.73E+00

5.58E+00

7.25E+00

5.58E+00

LogNormal

1.00

5.00

8.36E+00

2.79E+00

0.30

0.30

Each

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

0.30

LogNormal

1.3E+04

1.5E+05

0.30

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.022c

Cooling Tower - Capacity: < 100 Ton - Vibration isolated equipment that is not snubbed or restrained - Combined anchorage/isolator & equipment fragility

Costing is per unit and is based upon 75 Ton.

Line 457

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

TN 75

Peak Floor Acceleration

g

3

DS1

DS2

DS3

Mutually Exclusive

Mutually Exclusive

Mutually Exclusive

MutEx(DS1,DS2,DS3)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Damaged equipment and attached piping but anchorage OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

Damage State Probability:

0.35

0.15

0.50

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

User to Calculate

By User

Correlation (Yes / No)

NO

Data Quality

Average

Documentation Quality

Superior

Directionality (Yes / No)

NO

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Cooling tower removed, repaired offsite, and reinstalled.

Repair damaged equipment and attached piping. Cooling tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

NO

YES

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO₂eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

NO

NO

Not Applicable

Not Applicable

Not Applicable

0%

0.00

0%

0.00

NO

NO

NO

0%

0.00

0%

0.00

0%

0.00

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.022d

Cooling Tower - Capacity: 100 to <350 Ton - Vibration isolated equipment that is not snubbed or restrained - Anchorage fragility only

Costing is per unit and is based upon 250 Ton.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

TN 250

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

Mutually Exclusive

MutEx(DS1.DS2)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

0.70

none

0.30

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

By User

User to Calculate

User to Calculate

By User

NO

NO

Data Quality

Average

Data Relevance

Average

Documentation Quality

Superior

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Cooling tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

8.00E+02

1.50E+03

2.40E+03

Normal

1.00

5.00

1.65E+03

1.35E+03

0.40

0.40

Each

P₁₀

P₅₀

P₉₀

6.73E+04

7.95E+04

1.05E+05

LogNormal

1.00

5.00

8.75E+04

7.16E+04

0.18

0.18

Each

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

9.41E-02

1.77E-01

2.82E-01

Normal

1.00

5.00

1.94E-01

1.59E-01

0.47

0.47

Each

P₁₀

P₅₀

P₉₀

1.19E+00

1.40E+00

1.85E+00

LogNormal

1.00

5.00

2.34E+00

7.01E-01

0.31

0.31

Each

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

1.7E+02

Normal

0.47

Median Cost

Best Fit

CV or Beta

4.3E+04

LogNormal

0.31

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.022e

Cooling Tower - Capacity: 100 to <350 Ton - Vibration isolated equipment that is not snubbed or restrained - Equipment fragility only

Costing is per unit and is based upon 250 Ton.

Line 459

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

TN 250

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Damaged equipment and attached piping but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.97

0.6

0.1

0.6

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair damaged equipment and attached piping. Cooling tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

6.65E+04

7.80E+04

1.02E+05

8.09E+04

LogNormal

1.00

5.00

8.58E+04

7.02E+04

0.17

0.17

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.17E+01

1.38E+01

1.81E+01

1.38E+01

LogNormal

1.00

5.00

2.29E+01

6.88E+00

0.30

0.30

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO₂eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Median Cost

Best Fit

CV or Beta

4.3E+04

LogNormal

0.30

5.0E+05

LogNormal

0.30

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.022f

Cooling Tower - Capacity: 100 to <350 Ton - Vibration isolated equipment that is not snubbed or restrained - Combined anchorage/isolator & equipment fragility

Costing is per unit and is based upon 250 Ton.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

TN 250

Peak Floor Acceleration

g

3

DS1

DS2

DS3

Mutually Exclusive

Mutually Exclusive

Mutually Exclusive

MutEx(DS1,DS2,DS3)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Damaged equipment and attached piping but anchorage OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

none

none

0.35

0.15

0.50

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Cooling tower removed, repaired offsite, and reinstalled.

Repair damaged equipment and attached piping. Cooling tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES

YES

YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	8.00E+02	1.50E+03	2.40E+03	6.73E+04	7.95E+04	1.05E+05	6.65E+04	7.80E+04	1.02E+05						
Best fit mean:	1.57E+03 Normal			8.24E+04 LogNormal			8.09E+04 LogNormal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00						
Average Repair Cost (Min Qty, Max Qty)	1.65E+03		1.35E+03	8.75E+04		7.16E+04	8.58E+04		7.02E+04						
CV or beta (Min Qty, Max Qty)	0.40		0.40	0.18		0.18	0.17		0.17						
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.41E-01	1.76E+00	2.82E+00	1.19E+01	1.40E+01	1.85E+01	1.17E+01	1.38E+01	1.81E+01						
Best fit mean:	1.76E+00 Normal			1.40E+01 LogNormal			1.38E+01 LogNormal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00						
Average Repair Time (Min Qty, Max Qty)	1.94E+00		1.59E+00	2.34E+01		7.01E+00	2.29E+01		6.88E+00						
CV or beta (Min Qty, Max Qty)	0.47		0.47	0.31		0.31	0.30		0.30						
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.7E+02	Normal	0.47	4.3E+04	LogNormal	0.31	4.3E+04	LogNormal	0.30						
Embodied Energy (MJ)	5.0E+03	Normal	0.47	5.1E+05	LogNormal	0.31	5.0E+05	LogNormal	0.30						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			NO								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

Date Generated:

02/26/19

Line 461

Cooling Tower - Capacity: 350 to <750 Ton - Vibration isolated equipment that is not snubbed or restrained - Anchorage fragility only
Costing is per unit and is based upon 500 Ton.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		BLDG
Demand Location (floor above?)		No

Peak Floor Acceleration	2	Demand Location (floor above)		No
DS1	DS2			
Mutually Exclusive	Mutually Exclusive			
MutEx(DS1,DS2)				
Anchorage failure.	Anchorage failure & Equipment damaged beyond repair.			

none	none			
------	------	--	--	--

none	none		
0.70	0.30		

[illegible]

Bv User	Bv User			
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By User	By User			
User to Calculate	User to Calculate			

User to Calculate	User to Calculate			
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[illegible]

Repair anchorage and concrete pad and	Replace equipment including attached utilities
---------------------------------------	--

Repair anchorage and concrete pad and remount equipment.	Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Cooling tower removed, repaired offsite, and reinstalled.
--	---

YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.40E+03	2.20E+03	3.10E+03	1.12E+05	1.32E+05	1.74E+05												
Best fit mean:	2.23E+03			1.37E+05														
Best Fit Distribution:	Normal			LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00												
Average Repair Cost (Min Qty, Max Qty)	2.42E+03		1.98E+03	1.46E+05		1.19E+05												
CV or beta (Min Qty, Max Qty)	0.30		0.30	0.18		0.18												
Quantity Unit:	Each			Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.65E+00	2.59E+00	3.65E+00	1.31E+01	1.56E+01	2.04E+01												
Best fit mean:	2.59E+00			1.56E+01														
Best Fit Distribution:	Normal			LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00												
Average Repair Time (Min Qty, Max Qty)	2.85E+00		2.33E+00	3.12E+01		7.79E+00												
CV or beta (Min Qty, Max Qty)	0.39		0.39	0.31		0.31												
Quantity Unit:	Each			Each														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	2.5E+02	Normal	0.39	7.3E+04	LogNormal	0.31												
Embodied Energy (MJ)	7.4E+03	Normal	0.39	8.5E+05	LogNormal	0.31												
LifeSafety Hazard:	NO			NO														
Potential non-collapse casualties? (Yes / No)	NO			NO														
Casualty																		

Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.		
Date Created:	Not Given	Root Cost Multiplier:	1
Approved (YES / NO)?	By User	Date Generated:	02/26/19
Official (YES / NO) ?	By User		
Author:	Not Given		
Revisions:	2016-10-25 - Repair method clarified.		

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.022h

Cooling Tower - Capacity: 350 to <750 Ton - Vibration isolated equipment that is not snubbed or restrained - Equipment fragility only

Costing is per unit and is based upon 500 Ton.

Line 462

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

TN 500

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Damaged equipment and attached piping but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.97

0.6

0.1

0.6

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair damaged equipment and attached piping. Cooling tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.10E+05

1.30E+05

1.71E+05

1.35E+05

LogNormal

1.00

5.00

1.43E+05

1.17E+05

0.18

0.18

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.30E+01

1.53E+01

2.01E+01

1.53E+01

LogNormal

1.00

5.00

3.06E+01

7.66E+00

0.31

0.31

Each

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

7.2E+04

LogNormal

0.31

8.4E+05

LogNormal

0.31

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.022i

Cooling Tower - Capacity: 350 to <750 Ton - Vibration isolated equipment that is not snubbed or restrained - Combined anchorage/isolator & equipment fragility

Costing is per unit and is based upon 500 Ton.

Line 463

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

TN 500

Peak Floor Acceleration

g

3

DS1

DS2

DS3

Mutually Exclusive

Mutually Exclusive

Mutually Exclusive

MutEx(DS1,DS2,DS3)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Damaged equipment and attached piping but anchorage OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.35

0.15

0.50

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Cooling tower removed, repaired offsite, and reinstalled.

Repair damaged equipment and attached piping. Cooling tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES

YES

YES

Repair Costs:

Repair Time:

Environmental Impacts:

LifeSafety Hazard:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.40E+03

2.20E+03

3.10E+03

Normal

1.00

5.00

2.42E+03

1.98E+03

0.30

0.30

Each

P₁₀

P₅₀

P₉₀

1.12E+05

1.32E+05

1.74E+05

LogNormal

1.00

5.00

1.46E+05

1.19E+05

0.18

0.18

Each

P₁₀

P₅₀

P₉₀

1.10E+05

1.30E+05

1.71E+05

LogNormal

1.00

5.00

1.43E+05

1.17E+05

0.18

0.18

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

4.94E-01

7.77E-01

1.09E+00

Normal

1.00

5.00

8.54E-01

6.99E-01

0.39

0.39

Each

P₁₀

P₅₀

P₉₀

3.94E+00

4.67E+00

6.13E+00

LogNormal

1.00

5.00

9.35E+00

2.34E+00

0.31

0.31

Each

P₁₀

P₅₀

P₉₀

3.89E+00

4.60E+00

6.02E+00

LogNormal

1.00

5.00

9.19E+00

2.30E+00

0.31

0.31

Each

P₁₀

P₅₀

P₉₀

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

2.5E+02

Normal

0.39

7.3E+04

LogNormal

0.31

7.2E+04

LogNormal

0.31

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

7.4E+03

Normal

0.39

8.5E+05

LogNormal

0.31

8.4E+05

LogNormal

0.31

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.022k

Cooling Tower - Capacity: 750 to <1000 Ton - Vibration isolated equipment that is not snubbed or restrained - Equipment fragility only

Costing is per unit and is based upon 850 Ton.

Line 465

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

TN 850

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Damaged equipment and attached piping but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.00

0.97

0.6

0.1

0.6

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair damaged equipment and attached piping. Cooling tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.86E+05

2.19E+05

2.85E+05

2.26E+05

LogNormal

1.00

5.00

2.40E+05

1.97E+05

0.17

0.17

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.53E+01

1.80E+01

2.35E+01

1.80E+01

LogNormal

1.00

5.00

4.37E+01

9.00E+00

0.30

0.30

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

1.2E+05

LogNormal

0.30

1.4E+06

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.022I

Cooling Tower - Capacity: 750 to <1000 Ton - Vibration isolated equipment that is not snubbed or restrained - Combined anchorage/isolator & equipment fragility

Costing is per unit and is based upon 850 Ton.

Line 466

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

TN 850

Peak Floor Acceleration

g

3

DS1

DS2

DS3

Mutually Exclusive

Mutually Exclusive

Mutually Exclusive

MutEx(DS1,DS2,DS3)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Damaged equipment and attached piping but anchorage OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.35

0.15

0.50

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Cooling tower removed, repaired offsite, and reinstalled.

Repair damaged equipment and attached piping. Cooling tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES

YES

YES

Repair Costs:

Repair Time:

Environmental Impacts:

LifeSafety Hazard:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.60E+03

2.40E+03

3.40E+03

2.36E+03

LogNormal

1.00

5.00

2.64E+03

2.16E+03

0.29

0.29

Each

P₁₀

P₅₀

P₉₀

1.87E+05

2.21E+05

2.88E+05

2.28E+05

LogNormal

1.00

5.00

2.43E+05

1.99E+05

0.17

0.17

Each

P₁₀

P₅₀

P₉₀

1.86E+05

2.19E+05

2.85E+05

2.26E+05

LogNormal

1.00

5.00

2.40E+05

1.97E+05

0.17

0.17

Each

P₁₀

P₅₀

P₉₀

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

5.65E-01

8.47E-01

1.20E+00

8.47E-01

LogNormal

1.00

5.00

9.32E-01

7.62E-01

0.38

0.38

Each

P₁₀

P₅₀

P₉₀

4.62E+00

5.46E+00

7.12E+00

5.46E+00

LogNormal

1.00

5.00

1.33E+01

2.73E+00

0.30

0.30

Each

P₁₀

P₅₀

P₉₀

4.58E+00

5.40E+00

7.04E+00

5.40E+00

LogNormal

1.00

5.00

1.31E+01

2.70E+00

0.30

0.30

Each

P₁₀

P₅₀

P₉₀

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

2.5E+02

LogNormal

0.38

1.2E+05

LogNormal

0.30

1.2E+05

LogNormal

0.30

7.4E+03

LogNormal

0.38

1.4E+06

LogNormal

0.30

1.4E+06

LogNormal

0.30

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

Date Generated:

02/26/19

Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.		
Date Created:	Not Given	Root Cost Multiplier:	1
Approved (YES / NO)?	By User	Date Generated:	02/26/19
Official (YES / NO) ?	By User		
Author:	Not Given		
Revisions:	2016-10-25 - Repair method clarified.		

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.023b

Cooling Tower - Capacity: < 100 Ton - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragility only

Costing is per unit and is based upon 75 Ton.

Line 468

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

TN 75

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

Damaged equipment and attached piping but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.00

1.52

0.4

0.1

0.4

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair damaged equipment and attached piping. Cooling tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.01E+04

2.37E+04

3.08E+04

2.45E+04

LogNormal

1.00

5.00

2.61E+04

2.13E+04

0.17

0.17

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

4.73E+00

5.58E+00

7.25E+00

5.58E+00

LogNormal

1.00

5.00

8.36E+00

2.79E+00

0.30

0.30

Each

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

1.3E+04

LogNormal

0.30

1.5E+05

LogNormal

0.30

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

Date Generated:

02/26/19

Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.		
Date Created:	Not Given	Root Cost Multiplier:	1
Approved (YES / NO)?	By User	Date Generated:	02/26/19
Official (YES / NO) ?	By User		
Author:	Not Given		
Revisions:	2016-10-25 - Repair method clarified.		

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.023d

Cooling Tower - Capacity: 100 to <350 Ton - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragility only

Costing is per unit and is based upon 250 Ton.

Line 470

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

TN 250

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

Mutually Exclusive

MutEx(DS1.DS2)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

none

0.70

0.30

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Cooling tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES

YES

Repair Costs:

Repair Time:

Environmental Impacts:

LifeSafety Hazard:

P₁₀

P₅₀

P₉₀

8.00E+02

1.50E+03

2.40E+03

P₁₀

P₅₀

P₉₀

6.73E+04

7.95E+04

1.05E+05

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

1.57E+03

Normal

5.00

1.00

1.65E+03

1.35E+03

0.40

Each

8.24E+04

LogNormal

5.00

1.00

8.75E+04

0.18

0.18

Each

P₁₀

P₅₀

P₉₀

2.82E-01

5.29E-01

8.47E-01

P₁₀

P₅₀

P₉₀

3.56E+00

4.21E+00

5.54E+00

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

5.29E-01

Normal

5.00

1.00

5.82E-01

4.76E-01

0.47

Each

4.21E+00

LogNormal

5.00

1.00

7.01E+00

2.10E+00

0.31

Each

Median Cost

Best Fit

CV or Beta

1.7E+02

Normal

0.47

Median Cost

Best Fit

CV or Beta

4.3E+04

LogNormal

0.31

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

1.7E+02

Normal

0.47

4.3E+04

LogNormal

0.31

5.1E+05

LogNormal

0.31

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

NO

Not Applicable

0%

0.00

NO

Not Applicable

0%

0.00

NO

Not Applicable

0%

0.00

NO

Not Applicable

0%

0.00

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier: 1

Date Generated: 02/26/19

Root Cost Multiplier: 1
Date Generated: 02/26/19

Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.		
Date Created:	Not Given	Root Cost Multiplier:	1
Approved (YES / NO)?	By User	Date Generated:	02/26/19
Official (YES / NO) ?	By User		
Author:	Not Given		
Revisions:	2016-10-25 - Repair method clarified.		

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.023g

Cooling Tower - Capacity: 350 to <750 Ton - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragility only

Costing is per unit and is based upon 500 Ton.

Line 473

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

TN 500

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

Mutually Exclusive

MutEx(DS1.DS2)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

none

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.70

0.30

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Cooling tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

1.40E+03

2.20E+03

3.10E+03

P₁₀

P₅₀

P₉₀

1.12E+05

1.32E+05

1.74E+05

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.23E+03

Normal

1.00

5.00

1.37E+05

LogNormal

1.00

5.00

2.42E+03

1.98E+03

1.46E+05

1.19E+05

0.30

0.30

0.18

0.18

Each

Each

P₁₀

P₅₀

P₉₀

1.65E+00

2.59E+00

3.65E+00

P₁₀

P₅₀

P₉₀

1.31E+01

1.56E+01

2.04E+01

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.59E+00

Normal

1.00

5.00

1.56E+01

LogNormal

1.00

5.00

2.85E+00

2.33E+00

3.12E+01

7.79E+00

0.39

0.39

0.31

0.31

Each

Each

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

2.5E+02

Normal

0.39

7.3E+04

LogNormal

0.31

7.4E+03

Normal

0.39

8.5E+05

LogNormal

0.31

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

NO

NO

0%

0.00

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.023h

Cooling Tower - Capacity: 350 to <750 Ton - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragility only

Costing is per unit and is based upon 500 Ton.

Line 474

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

TN 500

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

Damaged equipment and attached piping but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.00

1.52

0.4

0.1

0.4

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair damaged equipment and attached piping. Cooling tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.10E+05

1.30E+05

1.71E+05

1.35E+05

LogNormal

1.00

5.00

1.43E+05

1.17E+05

0.18

0.18

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.30E+01

1.53E+01

2.01E+01

1.53E+01

LogNormal

1.00

5.00

3.06E+01

7.66E+00

0.31

0.31

Each

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

7.2E+04

LogNormal

0.31

8.4E+05

LogNormal

0.31

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.023i

Cooling Tower - Capacity: 350 to <750 Ton - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage/isola

Costing is per unit and is based upon 500 Ton.

Line 475

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

TN 500

Peak Floor Acceleration

g

3

DS1

Mutually Exclusive

MutEx(DS1,DS2,DS3)

Anchorage failure.

DS2

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

DS3

Mutually Exclusive

Damaged equipment and attached piping but anchorage OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

none

none

0.35

0.15

0.50

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Cooling tower removed, repaired offsite, and reinstalled.

Repair damaged equipment and attached piping. Cooling tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES

YES

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.40E+03

2.20E+03

3.10E+03

Normal

1.00

5.00

2.42E+03

0.30

0.30

Each

P₁₀

P₅₀

P₉₀

1.12E+05

1.32E+05

1.74E+05

LogNormal

1.00

5.00

1.46E+05

0.18

0.18

Each

P₁₀

P₅₀

P₉₀

1.10E+05

1.30E+05

1.71E+05

LogNormal

1.00

5.00

1.43E+05

0.18

0.18

Each

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

4.94E-01

7.77E-01

1.09E+00

Normal

1.00

5.00

8.54E-01

0.39

0.39

Each

P₁₀

P₅₀

P₉₀

3.94E+00

4.67E+00

6.13E+00

LogNormal

1.00

5.00

9.35E+00

0.31

0.31

Each

P₁₀

P₅₀

P₉₀

3.89E+00

4.60E+00

6.02E+00

LogNormal

1.00

5.00

9.19E+00

0.31

0.31

Each

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

2.5E+02

Normal

0.39

Median Cost

Best Fit

CV or Beta

7.3E+04

LogNormal

0.31

Median Cost

Best Fit

CV or Beta

7.2E+04

LogNormal

0.31

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.023j

Cooling Tower - Capacity: 750 to <1000 Ton - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragility only

Costing is per unit and is based upon 850 Ton.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

TN 850

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

Mutually Exclusive

MutEx(DS1.DS2)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none	none			
0.70	0.30			

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

NO

NO

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

Data Quality Average

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Cooling tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Costs:															
Repair Cost by Damage State:	1.60E+03	2.40E+03	3.40E+03	1.87E+05	2.21E+05	2.88E+05									
Best fit mean:	2.36E+03			2.28E+05											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00			5.00											
Average Repair Cost (Min Qty, Max Qty)	2.64E+03			2.16E+03			2.43E+05			1.99E+05					
CV or beta (Min Qty, Max Qty)	0.29			0.29			0.17			0.17					
Quantity Unit:	Each			Each											
Repair Time:															
Repair Time by Damage State:	1.88E+00	2.82E+00	4.00E+00	1.54E+01	1.82E+01	2.37E+01									
Best fit mean:	2.82E+00			1.82E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00			5.00			1.00			5.00					
Average Repair Time (Min Qty, Max Qty)	3.11E+00			2.54E+00			4.42E+01			9.10E+00					
CV or beta (Min Qty, Max Qty)	0.38			0.38			0.30			0.30					
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.5E+02	LogNormal	0.38	1.2E+05	LogNormal	0.30									
Embodied Energy (MJ)	7.4E+03	LogNormal	0.38	1.4E+06	LogNormal	0.30									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.023k

Cooling Tower - Capacity: 750 to <1000 Ton - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragility only

Costing is per unit and is based upon 850 Ton.

Line 477

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

TN 850

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

Damaged equipment and attached piping but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none				
1.00				

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.52

0.4

0.1

0.4

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions
Repair Description

Repair damaged equipment and attached piping. Cooling tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No) YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.86E+05	2.19E+05	2.85E+05												
Best fit mean:	2.26E+05														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Cost (Min Qty, Max Qty)	2.40E+05		1.97E+05												
CV or beta (Min Qty, Max Qty)	0.17		0.17												
Quantity Unit:	Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.53E+01	1.80E+01	2.35E+01												
Best fit mean:	1.80E+01														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Time (Min Qty, Max Qty)	4.37E+01		9.00E+00												
CV or beta (Min Qty, Max Qty)	0.30		0.30												
Quantity Unit:	Each														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.2E+05	LogNormal	0.30												
Embodied Energy (MJ)	1.4E+06	LogNormal	0.30												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.023I

Cooling Tower - Capacity: 750 to <1000 Ton - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage/isol

Costing is per unit and is based upon 850 Ton.

Line 478

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

TN 850

Peak Floor Acceleration

g

3

DS1

DS2

DS3

Mutually Exclusive

Mutually Exclusive

Mutually Exclusive

MutEx(DS1,DS2,DS3)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Damaged equipment and attached piping but anchorage OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.35

0.15

0.50

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Cooling tower removed, repaired offsite, and reinstalled.

Repair damaged equipment and attached piping. Cooling tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES

YES

YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.60E+03	2.40E+03	3.40E+03	1.87E+05	2.21E+05	2.88E+05	1.86E+05	2.19E+05	2.85E+05						
Best fit mean:	2.36E+03			2.28E+05			2.26E+05								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00						
Average Repair Cost (Min Qty, Max Qty)	2.64E+03		2.16E+03	2.43E+05		1.99E+05	2.40E+05		1.97E+05						
CV or beta (Min Qty, Max Qty)	0.29		0.29	0.17		0.17	0.17		0.17						
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.65E-01	8.47E-01	1.20E+00	4.62E+00	5.46E+00	7.12E+00	4.58E+00	5.40E+00	7.04E+00						
Best fit mean:	8.47E-01			5.46E+00			5.40E+00								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00						
Average Repair Time (Min Qty, Max Qty)	9.32E-01		7.62E-01	1.33E+01		2.73E+00	1.31E+01		2.70E+00						
CV or beta (Min Qty, Max Qty)	0.38		0.38	0.30		0.30	0.30		0.30						
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.5E+02	LogNormal	0.38	1.2E+05	LogNormal	0.30	1.2E+05	LogNormal	0.30						
Embodied Energy (MJ)	7.4E+03	LogNormal	0.38	1.4E+06	LogNormal	0.30	1.4E+06	LogNormal	0.30						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			NO								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

Date Generated:

02/26/19

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

D3032.011b

NISTIR Name
Description

Compressor - Capacity: Large non medical air supply - Unanchored equipment that is not vibration isolated - Equipment fragility only
Costing is per unit.

Line 480

Construction Quality:

Normal - Not designed for seismic loads

Seismic Installation Conditions:

Unanchored equipment that is not vibration isolated

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Peak Floor Acceleration g

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Mutually Exclusive

Mutually Exclusive

DS Hierarchy

MutEx(DS1.DS2)

Descriptions

Equipment does not function. Motor is damaged.

Equipment does not function.

Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations



none

Damage State Probability:

0.50

0.50

Fragility Parameters

Median Demand, θ :

0.25

0.25

Data dispersion, β_d :

0.4

0.40

Uncertainty, β_u :

0.25

0.25

Total Dispersion, β :

0.45

0.45

Correlation (Yes / No)

NO

Data Quality Average

Documentation Quality Superior

Directionality (Yes / No)

NO

Data Relevance Average

Rationality Superior

Consequence Functions

Repair Description

Repair motor.

Replace equipment.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.55E+03	3.00E+03	3.90E+03	6.66E+03	8.00E+03	1.07E+04									
Best fit mean:	3.10E+03			8.29E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00											
Average Repair Cost (Min Qty, Max Qty)	3.30E+03 2.70E+03			8.80E+03 7.20E+03											
CV or beta (Min Qty, Max Qty)	0.17 0.17			0.19 0.19											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	3.00E+00	3.53E+00	4.59E+00	7.84E-01	9.41E-01	1.26E+00									
Best fit mean:	3.53E+00			9.41E-01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00											
Average Repair Time (Min Qty, Max Qty)	3.88E+00 3.18E+00			1.88E+00 4.71E-01											
CV or beta (Min Qty, Max Qty)	0.30 0.30			0.32 0.32											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.3E+03	LogNormal	0.30	3.7E+03	LogNormal	0.32									
Embodied Energy (MJ)	1.6E+04	LogNormal	0.30	4.4E+04	LogNormal	0.32									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

None

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3032.011c

Compressor - Capacity: Small medical quality air supply - Unanchored equipment that is not vibration isolated - Equipment fragility only

Costing is per unit.

Line 481

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Unanchored equipment that is not vibration isolated

EA 1

Peak Floor Acceleration

2

DS1

DS2

Mutually Exclusive

Mutually Exclusive

MutEx(DS1.DS2)

Equipment does not function. Motor is damaged.

Equipment does not function.

Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D3032.011a-DS1-1.JPG

none

0.50

0.50

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.25

0.4

0.25

0.45

0.25

0.40

0.25

0.45

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair motor.

Replace equipment.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P10

P50

P90

7.70E+02

9.00E+02

1.17E+03

P10

P50

P90

6.61E+03

8.20E+03

1.14E+04

P10

P50

P90

P10

P50

P90

P10

P50

P90

9.32E+02

LogNormal

1.00

5.00

8.50E+03

LogNormal

1.00

5.00

9.90E+02

8.10E+02

0.17

0.17

9.02E+03

7.38E+03

0.22

0.22

Each

Each

P10

P50

P90

9.06E-01

1.06E+00

1.38E+00

1.06E+00

LogNormal

1.00

5.00

9.65E-01

LogNormal

1.00

5.00

1.16E+00

9.53E-01

0.30

0.30

1.93E+00

4.82E-01

0.33

0.33

Each

Each

Median Cost

Best Fit

CV or Beta

4.0E+02

LogNormal

0.30

3.8E+03

LogNormal

0.33

4.7E+03

LogNormal

0.30

4.6E+04

LogNormal

0.33

NO

Not Applicable

NO

Not Applicable

0%

0.00

0%

0.00

NO

NO

0%

0.00

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3032.011d

Compressor - Capacity: Large medical quality air supply - Unanchored equipment that is not vibration isolated - Equipment fragility only

Costing is per unit.

Line 482

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Unanchored equipment that is not vibration isolated

EA 1

Peak Floor Acceleration

2

DS1

DS2

Mutually Exclusive

MutEx(DS1.DS2)

Equipment does not function. Motor is damaged.

Equipment does not function.

Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D3032.011a-DS1-1.JPG

none

Damage State Probability:

0.50

0.50

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

0.25

0.4

0.25

0.45

0.25

0.40

0.25

0.45

Correlation (Yes / No)

NO

Data Quality

Average

Documentation Quality

Superior

Directionality (Yes / No)

NO

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair motor.

Replace equipment.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

3.40E+03

4.00E+03

5.20E+03

4.13E+03

LogNormal

1.00

5.00

4.40E+03

3.60E+03

0.17

0.17

Each

P₁₀

P₅₀

P₉₀

2.49E+04

3.00E+04

3.99E+04

3.10E+04

LogNormal

1.00

5.00

3.30E+04

2.70E+04

0.19

0.19

Each

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

4.00E+00

4.71E+00

6.12E+00

4.71E+00

LogNormal

1.00

5.00

5.18E+00

4.24E+00

0.30

0.30

Each

P₁₀

P₅₀

P₉₀

2.92E+00

3.53E+00

4.70E+00

3.53E+00

LogNormal

1.00

5.00

7.06E+00

1.76E+00

0.31

0.31

Each

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

1.8E+03

LogNormal

0.30

1.4E+04

LogNormal

0.31

Median Cost

Best Fit

CV or Beta

2.1E+04

LogNormal

0.30

1.6E+05

LogNormal

0.31

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3032.012a

Compressor - Capacity: Small non medical air supply - Vibration isolated equipment that is not snubbed or restrained - Anchorage fragility only

Costing is per unit.

Line 483

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

EA 1

Peak Floor Acceleration

2

DS1

Mutually Exclusive

MutEx(DS1.DS2)

Anchorage failure.

DS2

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D3032.011a-DS1-1.JPG

none

0.70

0.30

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

By User

User to Calculate

User to Calculate

By User

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

2.50E+02

4.50E+02

9.50E+02

2.46E+03

3.15E+03

4.63E+03

4.68E+02

LogNormal

1.00

5.00

4.95E+02

4.05E+02

0.55

0.55

Each

3.29E+03

LogNormal

1.00

5.00

3.47E+03

2.84E+03

0.26

0.26

Each

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

8.82E-02

1.59E-01

3.35E-01

8.68E-01

1.11E+00

1.63E+00

1.59E-01

LogNormal

1.00

5.00

1.75E-01

1.43E-01

0.60

0.60

Each

1.11E+00

LogNormal

1.00

5.00

1.22E+00

1.00E+00

0.36

0.36

Each

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

5.3E+01

LogNormal

0.60

1.2E+03

LogNormal

0.36

1.5E+03

LogNormal

0.60

1.5E+04

LogNormal

0.36

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3032.012b

Compressor - Capacity: Small non medical air supply - Vibration isolated equipment that is not snubbed or restrained - Equipment fragility only

Costing is per unit.

Line 484

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

EA 1

Peak Floor Acceleration

2

DS1

DS2

Mutually Exclusive

MutEx(DS1.DS2)

Equipment does not function but anchorage is OK. Motor is damaged.

Equipment does not function but anchorage is OK. Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D3032.011a-DS1-1.JPG

none

Damage State Probability:

0.50

0.50

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

0.47

0.2

0.1

0.2

0.47

0.20

0.1

0.2

Correlation (Yes / No)

NO

Data Quality

Average

Documentation Quality

Superior

Directionality (Yes / No)

NO

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair motor.

Replace equipment.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

6.40E+02

7.50E+02

9.80E+02

7.77E+02

LogNormal

1.00

5.00

8.25E+02

6.75E+02

0.17

0.17

Each

P₁₀

P₅₀

P₉₀

2.21E+03

2.70E+03

3.68E+03

2.80E+03

LogNormal

1.00

5.00

2.97E+03

2.43E+03

0.21

0.21

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

7.53E-01

8.82E-01

1.15E+00

8.82E-01

LogNormal

1.00

5.00

9.71E-01

7.94E-01

0.30

0.30

Each

P₁₀

P₅₀

P₉₀

2.60E-01

3.18E-01

4.33E-01

3.18E-01

LogNormal

1.00

5.00

6.35E-01

1.59E-01

0.32

0.32

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

3.4E+02

LogNormal

0.30

1.2E+03

LogNormal

0.32

Median Cost

Best Fit

CV or Beta

3.9E+03

LogNormal

0.30

1.4E+04

LogNormal

0.32

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3032.012c


Compressor - Capacity: Small non medical air supply - Vibration isolated equipment that is not snubbed or restrained - Combined anchorage/isolator & equipment fragility

Costing is per unit.

Line 485

Construction Quality:	Normal - Not designed for seismic loads			
Seismic Installation Conditions:	Vibration isolated equipment that is not snubbed or restrained			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Peak Floor Acceleration g			
Number of Damage States:	4			
Damage State:	DS1	DS2	DS3	DS4
Type of Damage State:	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive
DS Hierarchy	MutEx(DS1,DS2,DS3,DS4)			
Descriptions	Anchorage failure.	Anchorage failure & Equipment damaged beyond repair.	Motor damaged but anchorage is OK.	Equipment damaged beyond repair but anchorage is OK.

Illustrations

				
D3032.011a-DS1-1.JPG	none	none	none	
0.35	0.15	0.25	0.25	

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	By User	By User	By User	By User
Data dispersion, β_d :	User to Calculate	User to Calculate	User to Calculate	User to Calculate
Uncertainty, β_u :	User to Calculate	User to Calculate	User to Calculate	User to Calculate
Total Dispersion, β :	By User	By User	By User	By User
Correlation (Yes / No)	NO	Data Quality Average	Documentation Quality Superior	
Directionality (Yes / No)	NO	Data Relevance Average	Rationality Superior	

Consequence Functions				
Repair Description	Repair anchorage and concrete pad and remount equipment.	Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.	Repair Motor - Anchorage and Concrete do not require replacement	Replace and install equipment including new anchorage if anchorage is post-installed.

Long Lead Time (Yes / No) NO YES NO YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.50E+02	4.50E+02	9.50E+02	2.46E+03	3.15E+03	4.63E+03	6.40E+02	7.50E+02	9.80E+02	2.46E+03	3.15E+03	4.63E+03			
Best fit mean:	4.68E+02			3.29E+03			7.77E+02			3.29E+03					
Best Fit Distribution:	LogNormal			LogNormal			LogNormal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00			1.00 5.00			1.00 5.00					
Average Repair Cost (Min Qty, Max Qty)	4.95E+02 4.05E+02			3.47E+03 2.84E+03			8.25E+02 6.75E+02			3.47E+03 2.84E+03					
CV or beta (Min Qty, Max Qty)	0.55 0.55			0.26 0.26			0.17 0.17			0.26 0.26					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.94E-01	5.29E-01	1.12E+00	2.89E-01	3.71E-01	5.45E-01	7.53E-01	8.82E-01	1.15E+00	2.89E+00	3.71E+00	5.45E+00			
Best fit mean:	5.29E-01			3.71E-01			8.82E-01			3.71E+00					
Best Fit Distribution:	LogNormal			LogNormal			LogNormal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00			1.00 5.00			1.00 5.00					
Average Repair Time (Min Qty, Max Qty)	5.82E-01 4.76E-01			7.41E-01 1.85E-01			9.71E-01 7.94E-01			4.08E+00 3.34E+00					
CV or beta (Min Qty, Max Qty)	0.60 0.60			0.36 0.36			0.30 0.30			0.36 0.36					
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	5.3E+01	LogNormal	0.60	1.2E+03	LogNormal	0.36	3.4E+02	LogNormal	0.30	1.2E+03	LogNormal	0.36			
Embodied Energy (MJ)	1.5E+03	LogNormal	0.60	1.5E+04	LogNormal	0.36	3.9E+03	LogNormal	0.30	1.5E+04	LogNormal	0.36			
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			NO			NO			NO					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3032.012d

Compressor - Capacity: Large non medical air supply - Vibration isolated equipment that is not snubbed or restrained - Anchorage fragility only

Costing is per unit.

Line 486

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

EA 1

Peak Floor Acceleration

2

DS1

Mutually Exclusive

MutEx(DS1.DS2)

Anchorage failure.

DS2

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D3032.011a-DS1-1.JPG

none

0.70

0.30

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

Correlation (Yes / No)

Directionality (Yes / No)

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

5.50E+02

8.50E+02

1.60E+03

7.21E+03

8.85E+03

1.23E+04

8.98E+02

LogNormal

1.00

5.00

9.35E+02

7.65E+02

9.74E+03

7.97E+03

0.44

0.44

0.22

0.22

Each

Each

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.94E-01

3.00E-01

5.65E-01

2.54E+00

3.12E+00

4.35E+00

3.00E-01

LogNormal

1.00

5.00

3.30E-01

2.70E-01

3.44E+00

2.81E+00

0.51

0.51

0.33

0.33

Each

Each

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

9.1E+01

LogNormal

0.51

3.8E+03

LogNormal

0.33

2.6E+03

LogNormal

0.51

4.6E+04

LogNormal

0.33

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3032.012e

Compressor - Capacity: Large non medical air supply - Vibration isolated equipment that is not snubbed or restrained - Equipment fragility only

Costing is per unit.

Line 487

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

EA 1

Peak Floor Acceleration

2

DS1

DS2

Mutually Exclusive

MutEx(DS1.DS2)

Equipment does not function but anchorage is OK. Motor is damaged.

Equipment does not function but anchorage is OK. Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations



D3032.011a-DS1-1.JPG

none

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.50

0.47

0.2

0.1

0.2

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair motor.

Replace equipment.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

2.55E+03

3.00E+03

3.90E+03

P₁₀

P₅₀

P₉₀

6.66E+03

8.00E+03

1.07E+04

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

3.10E+03

LogNormal

5.00

P₁₀

P₅₀

P₉₀

8.29E+03

LogNormal

5.00

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.00

5.00

P₁₀

P₅₀

P₉₀

1.00

5.00

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

3.30E+03

2.70E+03

8.80E+03

7.20E+03

P₁₀

P₅₀

P₉₀

0.17

0.17

0.19

0.19

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Each

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

3.00E+00

3.53E+00

4.59E+00

P₁₀

P₅₀

P₉₀

7.84E-01

9.41E-01

1.26E+00

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

3.53E+00

LogNormal

5.00

P₁₀

P₅₀

P₉₀

9.41E-01

LogNormal

5.00

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.00

5.00

P₁₀

P₅₀

P₉₀

1.00

5.00

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

3.88E+00

3.18E+00

1.88E+00

4.71E-01

P₁₀

P₅₀

P₉₀

0.30

0.30

0.32

0.32

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Each

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Median Cost

Best Fit

CV or Beta

1.3E+03

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

3.7E+03

LogNormal

0.32

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

1.6E+04

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

4.4E+04

LogNormal

0.32

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

0%

0.00

NO

NO

0%

0.00

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description


D3032.012f

Compressor - Capacity: Large non medical air supply - Vibration isolated equipment that is not snubbed or restrained - Combined anchorage/isolator & equipment fragility

Costing is per unit.

Line 488

Construction Quality:	Normal - Not designed for seismic loads			
Seismic Installation Conditions:	Vibration isolated equipment that is not snubbed or restrained			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Peak Floor Acceleration g			
Number of Damage States:	4			
Damage State:	DS1	DS2	DS3	DS4
Type of Damage State:	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive
DS Hierarchy	MutEx(DS1,DS2,DS3,DS4)			
Descriptions	Anchorage failure.	Anchorage failure & Equipment damaged beyond repair.	Motor damaged but anchorage is OK.	Equipment damaged beyond repair but anchorage is OK.

Illustrations					
	D3032.011a-DS1-1.JPG	none	none	none	
	0.35	0.15	0.25	0.25	
Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	By User	By User	By User	By User	
Data dispersion, β_d :	User to Calculate	User to Calculate	User to Calculate	User to Calculate	
Uncertainty, β_u :	User to Calculate	User to Calculate	User to Calculate	User to Calculate	
Total Dispersion, β :	By User	By User	By User	By User	
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Superior	
Directionality (Yes / No)	NO	Data Relevance Average		Rationality Superior	
Consequence Functions					
Repair Description	Repair anchorage and concrete pad and remount equipment.	Replace equipment including attached utilities in addition to repairing anchorage and	Repair Motor - Anchorage and Concrete do not require replacement	Replace and install equipment including new anchorage if anchorage is post-installed.	

Long Lead Time (Yes / No)	NO			YES			NO			YES					
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	5.50E+02	8.50E+02	1.60E+03	7.21E+03	8.85E+03	1.23E+04	2.55E+03	3.00E+03	3.90E+03	7.21E+03	8.85E+03	1.23E+04			
Best fit mean:	8.98E+02			9.22E+03			3.10E+03			9.22E+03					
Best Fit Distribution:	LogNormal			LogNormal			LogNormal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	1.00	5.00		1.00	5.00		1.00	5.00		1.00	5.00				
Average Repair Cost (Min Qty, Max Qty)	9.35E+02	7.65E+02		9.74E+03	7.97E+03		3.30E+03	2.70E+03		9.74E+03	7.97E+03				
CV or beta (Min Qty, Max Qty)	0.44	0.44		0.22	0.22		0.17	0.17		0.22	0.22				
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	6.47E-01	1.00E+00	1.88E+00	8.48E-01	1.04E+00	1.45E+00	3.00E+00	3.53E+00	4.59E+00	8.48E+00	1.04E+01	1.45E+01			
Best fit mean:	1.00E+00			1.04E+00			3.53E+00			1.04E+01					
Best Fit Distribution:	LogNormal			LogNormal			LogNormal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	1.00	5.00		1.00	5.00		1.00	5.00		1.00	5.00				
Average Repair Time (Min Qty, Max Qty)	1.10E+00	9.00E-01		2.08E+00	5.21E-01		3.88E+00	3.18E+00		1.15E+01	9.37E+00				
CV or beta (Min Qty, Max Qty)	0.51	0.51		0.33	0.33		0.30	0.30		0.33	0.33				
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	9.1E+01	LogNormal	0.51	3.8E+03	LogNormal	0.33	1.3E+03	LogNormal	0.30	3.8E+03	LogNormal	0.33			
Embodied Energy (MJ)	2.6E+03	LogNormal	0.51	4.6E+04	LogNormal	0.33	1.6E+04	LogNormal	0.30	4.6E+04	LogNormal	0.33			
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			NO			NO			NO					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3032.012g

Compressor - Capacity: Small medical quality air supply - Vibration isolated equipment that is not snubbed or restrained - Anchorage fragility only

Costing is per unit.

Line 489

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

EA 1

Peak Floor Acceleration

2

DS1

Mutually Exclusive

MutEx(DS1.DS2)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D3032.011a-DS1-1.JPG

none

0.70

0.30

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

NO

NO

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

2.50E+02

4.50E+02

9.50E+02

6.86E+03

8.65E+03

1.23E+04

P₁₀

P₅₀

P₉₀

4.68E+02

LogNormal

5.00

1.00

5.00

4.95E+02

4.05E+02

9.52E+03

7.79E+03

0.55

0.55

0.24

Each

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

2.94E-01

5.29E-01

1.12E+00

8.07E-01

1.02E+00

1.45E+00

P₁₀

P₅₀

P₉₀

5.29E-01

LogNormal

5.00

1.00

5.00

5.82E-01

4.76E-01

2.04E+00

5.09E-01

0.60

0.60

0.35

Each

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

5.3E+01

LogNormal

0.60

3.9E+03

LogNormal

0.35

1.5E+03

LogNormal

0.60

4.7E+04

LogNormal

0.35

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

NO

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3032.012i

Compressor - Capacity: Small medical quality air supply - Vibration isolated equipment that is not snubbed or restrained - Combined anchorage/isolator & equipment fra

Costing is per unit.

Line 491

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

EA 1

Peak Floor Acceleration

g

4

DS1

DS2

DS3

DS4

Mutually Exclusive

Mutually Exclusive

Mutually Exclusive

Mutually Exclusive

MutEx(DS1,DS2,DS3,DS4)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Motor damaged but anchorage is OK.

Equipment damaged beyond repair but anchorage is OK.

Quantity Rounding

Round Qty?

YES


Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

				
D3032.011a-DS1-1.JPG	none	none	none	
0.35	0.15	0.25	0.25	

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	By User	By User	By User	By User	
Data dispersion, β_d :	User to Calculate	User to Calculate	User to Calculate	User to Calculate	
Uncertainty, β_u :	User to Calculate	User to Calculate	User to Calculate	User to Calculate	
Total Dispersion, β :	By User	By User	By User	By User	
Correlation (Yes / No)	NO	Data Quality	Average	Documentation Quality	Superior
Directionality (Yes / No)	NO	Data Relevance	Average	Rationality	Superior

Consequence Functions					
Repair Description	Repair anchorage and concrete pad and remount equipment.	Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.	Repair Motor - Anchorage and Concrete do not require replacement	Replace and install equipment including new anchorage if anchorage is post-installed.	

Long Lead Time (Yes / No) NO YES NO YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.50E+02	4.50E+02	9.50E+02	6.86E+03	8.65E+03	1.23E+04	7.70E+02	9.00E+02	1.17E+03	6.86E+03	8.65E+03	1.23E+04			
Best fit mean:	4.68E+02			8.99E+03			9.32E+02			8.99E+03					
Best Fit Distribution:	LogNormal			LogNormal			LogNormal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00	1.00		5.00			
Average Repair Cost (Min Qty, Max Qty)	4.95E+02		4.05E+02	9.52E+03		7.79E+03	9.90E+02		8.10E+02	9.52E+03		7.79E+03			
CV or beta (Min Qty, Max Qty)	0.55		0.55	0.24		0.24	0.17		0.17	0.24		0.24			
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.82E-02	1.59E-01	3.35E-01	2.42E+00	3.05E+00	4.35E+00	2.72E-01	3.18E-01	4.13E-01	2.42E+00	3.05E+00	4.35E+00			
Best fit mean:	1.59E-01			3.05E+00			3.18E-01			3.05E+00					
Best Fit Distribution:	LogNormal			LogNormal			LogNormal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00	1.00		5.00			
Average Repair Time (Min Qty, Max Qty)	1.75E-01		1.43E-01	3.36E+00		2.75E+00	3.49E-01		2.86E-01	3.36E+00		2.75E+00			
CV or beta (Min Qty, Max Qty)	0.60		0.60	0.35		0.35	0.30		0.30	0.35		0.35			
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	5.3E+01	LogNormal	0.60	3.9E+03	LogNormal	0.35	4.0E+02	LogNormal	0.30	3.9E+03	LogNormal	0.35			
Embodied Energy (MJ)	1.5E+03	LogNormal	0.60	4.7E+04	LogNormal	0.35	4.7E+03	LogNormal	0.30	4.7E+04	LogNormal	0.35			
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00				
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00				
Post-event Tagging Flag:	NO			NO			NO			NO					
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00				

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3032.012j

Compressor - Capacity: Large medical quality air supply - Vibration isolated equipment that is not snubbed or restrained - Anchorage fragility only

Costing is per unit.

Line 492

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

EA 1

Peak Floor Acceleration

2

DS1

Mutually Exclusive

MutEx(DS1.DS2)

Anchorage failure.

DS2

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D3032.011a-DS1-1.JPG

none

0.70

0.30

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

NO

NO

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

5.50E+02

8.50E+02

1.60E+03

2.54E+04

3.09E+04

4.15E+04

8.98E+02

LogNormal

1.00

5.00

1.00

5.00

0.44

0.44

Each

3.19E+04

LogNormal

1.00

5.00

0.20

0.20

Each

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

6.47E-01

1.00E+00

1.88E+00

2.99E+00

3.63E+00

4.89E+00

1.00E+00

LogNormal

1.00

5.00

1.00

5.00

0.51

0.51

Each

3.63E+00

LogNormal

1.00

5.00

0.32

0.32

Each

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

9.1E+01

LogNormal

0.51

1.4E+04

LogNormal

0.32

2.6E+03

LogNormal

0.51

1.6E+05

LogNormal

0.32

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

NO

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3032.012k

Compressor - Capacity: Large medical quality air supply - Vibration isolated equipment that is not snubbed or restrained - Equipment fragility only

Costing is per unit.

Line 493

Construction Quality: Normal - Not designed for seismic loads

Seismic Installation Conditions: Vibration isolated equipment that is not snubbed or restrained

Fragility Unit of Measure: EA 1

Demand Parameter (unit): Peak Floor Acceleration g

Number of Damage States: 2

Damage State: DS1

Type of Damage State: Mutually Exclusive

DS Hierarchy: MutEx(DS1.DS2)

Descriptions: Equipment does not function but anchorage is OK. Motor is damaged.

Quantity Rounding Round Qty? YES

Allow sum by floor or building? BLDG

Demand Location (floor above?) No

Damage State: DS2

Type of Damage State: Mutually Exclusive

DS Hierarchy: MutEx(DS1.DS2)

Descriptions: Equipment does not function but anchorage is OK. Equipment damaged beyond repair.

Illustrations



D3032.011a-DS1-1.JPG

none

Damage State Probability:

0.50

0.50

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β_t :

0.47

0.2

0.1

0.2

0.47

0.20

0.1

0.2

Correlation (Yes / No)

NO

Data Quality Average

Documentation Quality Superior

Directionality (Yes / No)

NO

Data Relevance Average

Rationality Superior

Consequence Functions

Repair Description

Repair motor.

Replace equipment.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

3.40E+03

4.00E+03

5.20E+03

2.49E+04

3.00E+04

3.99E+04

4.13E+03

LogNormal

1.00

5.00

1.00

5.00

0.17

0.17

Each

3.10E+04

LogNormal

1.00

5.00

0.19

0.19

Each

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

4.00E+00

4.71E+00

6.12E+00

2.92E+00

3.53E+00

4.70E+00

4.71E+00

LogNormal

1.00

5.00

5.18E+00

4.24E+00

0.30

0.30

Each

3.53E+00

LogNormal

1.00

5.00

7.06E+00

1.76E+00

0.31

0.31

Each

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

1.8E+03

LogNormal

0.30

1.4E+04

LogNormal

0.31

2.1E+04

LogNormal

0.30

1.6E+05

LogNormal

0.31

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description


D3032.012I

Compressor - Capacity: Large medical quality air supply - Vibration isolated equipment that is not snubbed or restrained - Combined anchorage/isolator & equipment fra

Costing is per unit.

Line 494

Construction Quality:	Normal - Not designed for seismic loads			
Seismic Installation Conditions:	Vibration isolated equipment that is not snubbed or restrained			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Peak Floor Acceleration g			
Number of Damage States:	4			
Damage State:	DS1	DS2	DS3	DS4
Type of Damage State:	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive
DS Hierarchy	MutEx(DS1,DS2,DS3,DS4)			
Descriptions	Anchorage failure.	Anchorage failure & Equipment damaged beyond repair.	Motor damaged but anchorage is OK.	Equipment damaged beyond repair but anchorage is OK.

Illustrations					
	D3032.011a-DS1-1.JPG	none	none	none	
	0.35	0.15	0.25	0.25	
Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	By User	By User	By User	By User	
Data dispersion, β_d :	User to Calculate	User to Calculate	User to Calculate	User to Calculate	
Uncertainty, β_u :	User to Calculate	User to Calculate	User to Calculate	User to Calculate	
Total Dispersion, β :	By User	By User	By User	By User	
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Superior	
Directionality (Yes / No)	NO	Data Relevance Average		Rationality Superior	
Consequence Functions					
Repair Description	Repair anchorage and concrete pad and remount equipment.	Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.	Repair Motor - Anchorage and Concrete do not require replacement	Replace and install equipment including new anchorage if anchorage is post-installed.	

Long Lead Time (Yes / No)	NO			YES			NO			YES					
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	5.50E+02	8.50E+02	1.60E+03	2.54E+04	3.09E+04	4.15E+04	3.40E+03	4.00E+03	5.20E+03	2.54E+04	3.09E+04	4.15E+04			
Best fit mean:	8.98E+02 LogNormal			3.19E+04 LogNormal			4.13E+03 LogNormal			3.19E+04 LogNormal					
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	1.00	5.00		1.00	5.00		1.00	5.00		1.00	5.00				
Average Repair Cost (Min Qty, Max Qty)	9.35E+02	7.65E+02		3.39E+04	2.78E+04		4.40E+03	3.60E+03		3.39E+04	2.78E+04				
CV or beta (Min Qty, Max Qty)	0.44	0.44		0.20	0.20		0.17	0.17		0.20	0.20				
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.94E-01	3.00E-01	5.65E-01	8.97E+00	1.09E+01	1.47E+01	1.20E+00	1.41E+00	1.84E+00	8.97E+00	1.09E+01	1.47E+01			
Best fit mean:	3.00E-01 LogNormal			1.09E+01 LogNormal			1.41E+00 LogNormal			1.09E+01 LogNormal					
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	1.00	5.00		1.00	5.00		1.00	5.00		1.00	5.00				
Average Repair Time (Min Qty, Max Qty)	3.30E-01	2.70E-01		1.20E+01	9.80E+00		1.55E+00	1.27E+00		1.20E+01	9.80E+00				
CV or beta (Min Qty, Max Qty)	0.51	0.51		0.32	0.32		0.30	0.30		0.32	0.32				
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	9.1E+01	LogNormal	0.51	1.4E+04	LogNormal	0.32	1.8E+03	LogNormal	0.30	1.4E+04	LogNormal	0.32			
Embodied Energy (MJ)	2.6E+03	LogNormal	0.51	1.6E+05	LogNormal	0.32	2.1E+04	LogNormal	0.30	1.6E+05	LogNormal	0.32			
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			NO			NO			NO					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3032.013a

Compressor - Capacity: Small non medical air supply - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragili

Costing is per unit.

Line 495

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

EA 1

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

MutEx(DS1.DS2)

Anchorage failure.

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations



D3032.011a-DS1-1.JPG

none

0.30

Damage State Probability:

0.70

0.30

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

2.50E+02

4.50E+02

9.50E+02

LogNormal

1.00

5.00

4.95E+02

0.55

0.55

Each

P₁₀

P₅₀

P₉₀

2.46E+03

3.15E+03

4.63E+03

LogNormal

1.00

5.00

3.47E+03

0.26

0.26

Each

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

8.82E-02

1.59E-01

3.35E-01

LogNormal

1.00

5.00

1.75E-01

0.60

0.60

Each

P₁₀

P₅₀

P₉₀

8.68E-01

1.11E+00

1.63E+00

LogNormal

1.00

5.00

1.22E+00

0.36

0.36

Each

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

5.3E+01

LogNormal

0.60

Median Cost

Best Fit

CV or Beta

1.2E+03

LogNormal

0.36

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3032.013b

Compressor - Capacity: Small non medical air supply - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragility
Costing is per unit.

Line 496

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

EA 1

Peak Floor Acceleration

2

DS1

DS2

Mutually Exclusive

MutEx(DS1.DS2)

Equipment does not function but anchorage is OK. Motor is damaged.

Equipment does not function but anchorage is OK. Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations



Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Consequence Functions

Repair Description

0.50

1.84

0.6

0.1

0.6

NO

NO

Repair motor.

0.50

1.84

0.60

0.1

0.6

Data Quality Average

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Replace equipment.

Long Lead Time (Yes / No) NO YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	6.40E+02	7.50E+02	9.80E+02	2.21E+03	2.70E+03	3.68E+03									
Best fit mean:	7.77E+02			2.80E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00											
Average Repair Cost (Min Qty, Max Qty)	8.25E+02 6.75E+02			2.97E+03 2.43E+03											
CV or beta (Min Qty, Max Qty)	0.17 0.17			0.21 0.21											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	7.53E-01	8.82E-01	1.15E+00	2.60E-01	3.18E-01	4.33E-01									
Best fit mean:	8.82E-01			3.18E-01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00											
Average Repair Time (Min Qty, Max Qty)	9.71E-01 7.94E-01			6.35E-01 1.59E-01											
CV or beta (Min Qty, Max Qty)	0.30 0.30			0.32 0.32											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	3.4E+02	LogNormal	0.30	1.2E+03	LogNormal	0.32									
Embodied Energy (MJ)	3.9E+03	LogNormal	0.30	1.4E+04	LogNormal	0.32									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description


D3032.013c

Compressor - Capacity: Small non medical air supply - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined ancho

Costing is per unit.

Line 497

Construction Quality:	Normal - Designed for seismic loads but no special seismic certification			
Seismic Installation Conditions:	Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Peak Floor Acceleration g			
Number of Damage States:	4			
Damage State:	DS1	DS2	DS3	DS4
Type of Damage State:	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive
DS Hierarchy	MutEx(DS1,DS2,DS3,DS4)			
Descriptions	Anchorage failure.	Anchorage failure & Equipment damaged beyond repair.	Motor damaged but anchorage is OK.	Equipment damaged beyond repair but anchorage is OK.

Illustrations					
	D3032.011a-DS1-1.JPG	none	none	none	
Damage State Probability:	0.35	0.15	0.25	0.25	
Fragility Parameters					
Median Demand, θ :	By User	By User	By User	By User	
Data dispersion, β_d :	User to Calculate	User to Calculate	User to Calculate	User to Calculate	
Uncertainty, β_u :	User to Calculate	User to Calculate	User to Calculate	User to Calculate	
Total Dispersion, β :	By User	By User	By User	By User	
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Superior	
Directionality (Yes / No)	NO	Data Relevance Average		Rationality Superior	
Consequence Functions					
Repair Description	Repair anchorage and concrete pad and remount equipment.	Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.	Repair Motor - Anchorage and Concrete do not require repair.	Replace and install equipment including new anchorage if anchorage is post-installed.	

Long Lead Time (Yes / No)	NO	YES	NO	YES	
Repair Costs:	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}
Repair Cost by Damage State:	2.50E+02 4.50E+02 9.50E+02	2.46E+03 3.15E+03 4.63E+03	6.40E+02 7.50E+02 9.80E+02	2.46E+03 3.15E+03 4.63E+03	
Best fit mean:	4.68E+02	3.29E+03	7.77E+02	3.29E+03	
Best Fit Distribution:	LogNormal	LogNormal	LogNormal	LogNormal	
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00	1.00 5.00	1.00 5.00	1.00 5.00	
Average Repair Cost (Min Qty, Max Qty)	4.95E+02 4.05E+02	3.47E+03 2.84E+03	8.25E+02 6.75E+02	3.47E+03 2.84E+03	
CV or beta (Min Qty, Max Qty)	0.55 0.55	0.26 0.26	0.17 0.17	0.26 0.26	
Quantity Unit:	Each	Each	Each	Each	
Repair Time:	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}
Repair Time by Damage State:	2.94E-01 5.29E-01 1.12E+00	8.68E-01 1.11E+00 1.63E+00	7.53E-01 8.82E-01 1.15E+00	2.89E+00 3.71E+00 5.45E+00	
Best fit mean:	5.29E-01	1.11E+00	8.82E-01	3.71E+00	
Best Fit Distribution:	LogNormal	LogNormal	LogNormal	LogNormal	
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00	1.00 5.00	1.00 5.00	1.00 5.00	
Average Repair Time (Min Qty, Max Qty)	5.82E-01 4.76E-01	1.48E+00 7.41E-01	9.71E-01 7.94E-01	4.08E+00 3.34E+00	
CV or beta (Min Qty, Max Qty)	0.60 0.60	0.36 0.36	0.30 0.30	0.36 0.36	
Quantity Unit:	Each	Each	Each	Each	
Environmental Impacts:	Median Cost Best Fit CV or Beta	Median Cost Best Fit CV or Beta	Median Cost Best Fit CV or Beta	Median Cost Best Fit CV or Beta	Median Cost Best Fit CV or Beta
Embodied Carbon (kg CO2eq)	5.3E+01 LogNormal 0.60	1.2E+03 LogNormal 0.36	3.4E+02 LogNormal 0.30	1.2E+03 LogNormal 0.36	
Embodied Energy (MJ)	1.5E+03 LogNormal 0.60	1.5E+04 LogNormal 0.36	3.9E+03 LogNormal 0.30	1.5E+04 LogNormal 0.36	
LifeSafety Hazard:					
Potential non-collapse casualties? (Yes / No)	NO	NO	NO	NO	
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable	Not Applicable	Not Applicable	Not Applicable	
Serious Injury (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00	0% 0.00	
Loss of Life (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00	0% 0.00	
Post-event Tagging Flag:	NO	NO	NO	NO	
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00	0% 0.00	

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3032.013d

Compressor - Capacity: Large non medical air supply - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragili

Costing is per unit.

Line 498

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

EA 1

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

Mutually Exclusive

MutEx(DS1.DS2)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations



Damage State Probability:

0.70

0.30

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

Correlation (Yes / No)

NO

Data Quality

Average

Documentation Quality

Superior

Directionality (Yes / No)

NO

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Long Lead Time (Yes / No) NO YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	5.50E+02	8.50E+02	1.60E+03	7.21E+03	8.85E+03	1.23E+04									
Best fit mean:	8.98E+02			9.22E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00			5.00											
Average Repair Cost (Min Qty, Max Qty)	9.35E+02			7.65E+02			9.74E+03			7.97E+03					
CV or beta (Min Qty, Max Qty)	0.44			0.44			0.22			0.22					
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.94E-01	3.00E-01	5.65E-01	2.54E+00	3.12E+00	4.35E+00									
Best fit mean:	3.00E-01			3.12E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00			5.00			1.00			5.00					
Average Repair Time (Min Qty, Max Qty)	3.30E-01			2.70E-01			3.44E+00			2.81E+00					
CV or beta (Min Qty, Max Qty)	0.51			0.51			0.33			0.33					
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	9.1E+01	LogNormal	0.51	3.8E+03	LogNormal	0.33									
Embodied Energy (MJ)	2.6E+03	LogNormal	0.51	4.6E+04	LogNormal	0.33									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%			0.00			0%			0.00					
Loss of Life (Median, Dispersion)	0%			0.00			0%			0.00					
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%			0.00			0%			0.00					

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3032.013e

Compressor - Capacity: Large non medical air supply - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragility

Line 499

Costing is per unit.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

EA 1

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

Mutually Exclusive

MutEx(DS1.DS2)

Equipment does not function but anchorage is OK. Motor is damaged.

Equipment does not function but anchorage is OK. Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations



Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Consequence Functions

Repair Description

0.50

0.50

1.84

0.6

0.1

0.6

NO

NO

Repair motor.

Replace equipment.

Data Quality Average

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Long Lead Time (Yes / No)

NO YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.55E+03	3.00E+03	3.90E+03	6.66E+03	8.00E+03	1.07E+04									
Best fit mean:	3.10E+03			8.29E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00											
Average Repair Cost (Min Qty, Max Qty)	3.30E+03 2.70E+03			8.80E+03 7.20E+03											
CV or beta (Min Qty, Max Qty)	0.17 0.17			0.19 0.19											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	3.00E+00	3.53E+00	4.59E+00	7.84E-01	9.41E-01	1.26E+00									
Best fit mean:	3.53E+00			9.41E-01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00											
Average Repair Time (Min Qty, Max Qty)	3.88E+00 3.18E+00			1.88E+00 4.71E-01											
CV or beta (Min Qty, Max Qty)	0.30 0.30			0.32 0.32											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.3E+03	LogNormal	0.30	3.7E+03	LogNormal	0.32									
Embodied Energy (MJ)	1.6E+04	LogNormal	0.30	4.4E+04	LogNormal	0.32									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description


D3032.013f

Compressor - Capacity: Large non medical air supply - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined ancho

Costing is per unit.

Line 500

Construction Quality:	Normal - Designed for seismic loads but no special seismic certification			
Seismic Installation Conditions:	Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Peak Floor Acceleration g			
Number of Damage States:	4			
Damage State:	DS1	DS2	DS3	DS4
Type of Damage State:	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive
DS Hierarchy	MutEx(DS1,DS2,DS3,DS4)			
Descriptions	Anchorage failure.	Anchorage failure & Equipment damaged beyond repair.	Motor damaged but anchorage is OK.	Equipment damaged beyond repair but anchorage is OK.

Illustrations									
	D3032.011a-DS1-1.JPG	none	none	none					
	0.35	0.15	0.25	0.25					
Damage State Probability:									
Fragility Parameters									
Median Demand, θ :	By User	By User	By User	By User					
Data dispersion, β_d :	User to Calculate	User to Calculate	User to Calculate	User to Calculate					
Uncertainty, β_u :	User to Calculate	User to Calculate	User to Calculate	User to Calculate					
Total Dispersion, β :	By User	By User	By User	By User					
Correlation (Yes / No)	NO	Data Quality Average			Documentation Quality Superior				
Directionality (Yes / No)	NO	Data Relevance Average			Rationality Superior				
Consequence Functions									
Repair Description	Repair anchorage and concrete pad and remount equipment.	Replace equipment including attached utilities in addition to repairing anchorage and	Repair Motor - Anchorage and Concrete do not require repair.	Replace and install equipment including new anchorage if anchorage is post-installed.					

Long Lead Time (Yes / No)	NO			YES			NO			YES					
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	5.50E+02	8.50E+02	1.60E+03	7.21E+03	8.85E+03	1.23E+04	2.55E+03	3.00E+03	3.90E+03	7.21E+03	8.85E+03	1.23E+04			
Best fit mean:	8.98E+02			9.22E+03			3.10E+03			9.22E+03					
Best Fit Distribution:	LogNormal			LogNormal			LogNormal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	1.00	5.00		1.00	5.00		1.00	5.00		1.00	5.00				
Average Repair Cost (Min Qty, Max Qty)	9.35E+02	7.65E+02		9.74E+03	7.97E+03		3.30E+03	2.70E+03		9.74E+03	7.97E+03				
CV or beta (Min Qty, Max Qty)	0.44	0.44		0.22	0.22		0.17	0.17		0.22	0.22				
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	6.47E-01	1.00E+00	1.88E+00	2.54E+00	3.12E+00	4.35E+00	3.00E+00	3.53E+00	4.59E+00	8.48E+00	1.04E+01	1.45E+01			
Best fit mean:	1.00E+00			3.12E+00			3.53E+00			1.04E+01					
Best Fit Distribution:	LogNormal			LogNormal			LogNormal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	1.00	5.00		1.00	5.00		1.00	5.00		1.00	5.00				
Average Repair Time (Min Qty, Max Qty)	1.10E+00	9.00E-01		4.16E+00	2.08E+00		3.88E+00	3.18E+00		1.15E+01	9.37E+00				
CV or beta (Min Qty, Max Qty)	0.51	0.51		0.33	0.33		0.30	0.30		0.33	0.33				
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	9.1E+01	LogNormal	0.51	3.8E+03	LogNormal	0.33	1.3E+03	LogNormal	0.30	3.8E+03	LogNormal	0.33			
Embodied Energy (MJ)	2.6E+03	LogNormal	0.51	4.6E+04	LogNormal	0.33	1.6E+04	LogNormal	0.30	4.6E+04	LogNormal	0.33			
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			NO			NO			NO					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3032.013g

Compressor - Capacity: Small medical quality air supply - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fra

Costing is per unit.

Line 501

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

EA 1

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

Mutually Exclusive

MutEx(DS1.DS2)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D3032.011a-DS1-1.JPG

none

0.30

0.70

0.30

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

By User

User to Calculate

User to Calculate

By User

NO

NO

Data Quality

Average

Data Relevance

Average

Documentation Quality

Superior

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

2.50E+02

4.50E+02

9.50E+02

6.86E+03

8.65E+03

1.23E+04

4.68E+02

LogNormal

1.00

5.00

4.95E+02

4.05E+02

9.52E+03

7.79E+03

0.55

0.55

0.24

Each

P₁₀

P₅₀

P₉₀

5.82E+01

5.29E-01

1.12E+00

8.07E-01

1.02E+00

1.45E+00

5.29E-01

LogNormal

1.00

5.00

5.82E-01

4.76E-01

2.04E+00

5.09E-01

0.60

0.60

0.35

Each

P₁₀

P₅₀

P₉₀

3.9E+03

LogNormal

0.35

4.7E+04

LogNormal

0.35

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3032.013h

Compressor - Capacity: Small medical quality air supply - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

Costing is per unit.

Line 502

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

EA 1

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

Mutually Exclusive

MutEx(DS1.DS2)

Equipment does not function but anchorage is OK. Motor is damaged.

Equipment does not function but anchorage is OK. Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D3032.011a-DS1-1.JPG

none

0.50

0.50

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

1.84

0.6

0.1

0.6

Correlation (Yes / No)

NO

Data Quality

Average

Documentation Quality

Superior

Directionality (Yes / No)

NO

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair motor.

Replace equipment.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

7.70E+02

9.00E+02

1.17E+03

6.61E+03

8.20E+03

1.14E+04

9.32E+02

LogNormal

8.50E+03

LogNormal

1.00

5.00

1.00

5.00

9.90E+02

8.10E+02

9.02E+03

7.38E+03

0.17

0.17

0.22

0.22

Each

Each

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

9.06E-01

1.06E+00

1.38E+00

2.33E+00

2.89E+00

4.02E+00

1.06E+00

LogNormal

2.89E+00

LogNormal

1.00

5.00

1.00

5.00

1.16E+00

9.53E-01

3.86E+00

1.93E+00

0.30

0.30

0.33

0.33

Each

Each

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

4.0E+02

LogNormal

0.30

3.8E+03

LogNormal

0.33

4.7E+03

LogNormal

0.30

4.6E+04

LogNormal

0.33

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.		
Date Created:	Not Given	Root Cost Multiplier:	1
Approved (YES / NO)?	By User	Date Generated:	02/26/19
Official (YES / NO) ?	By User		
Author:	Not Given		
Revisions:	None		

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3032.013j

Compressor - Capacity: Large medical quality air supply - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fra

Costing is per unit.

Line 504

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

EA 1

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

Mutually Exclusive

MutEx(DS1.DS2)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D3032.011a-DS1-1.JPG

none

0.70

0.30

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

By User

User to Calculate

User to Calculate

By User

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorages and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorages and concrete pad.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

5.50E+02

8.50E+02

1.60E+03

LogNormal

1.00

5.00

9.35E+02

7.65E+02

0.44

0.44

Each

P₁₀

P₅₀

P₉₀

2.54E+04

3.09E+04

4.15E+04

LogNormal

1.00

5.00

3.39E+04

2.78E+04

0.20

0.20

Each

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

6.47E-01

1.00E+00

1.88E+00

LogNormal

1.00

5.00

1.10E+00

9.00E-01

0.51

0.51

Each

P₁₀

P₅₀

P₉₀

2.99E+00

3.63E+00

4.89E+00

LogNormal

1.00

5.00

7.26E+00

1.81E+00

0.32

0.32

Each

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

9.1E+01

LogNormal

0.51

Median Cost

Best Fit

CV or Beta

1.4E+04

LogNormal

0.32

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3032.013k

Compressor - Capacity: Large medical quality air supply - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

Costing is per unit.

Line 505

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

EA 1

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

Mutually Exclusive

MutEx(DS1.DS2)

Equipment does not function but anchorage is OK. Motor is damaged.

Equipment does not function but anchorage is OK. Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations



Damage State Probability:

0.50

0.50

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

NO

NO

Data Quality Average

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Consequence Functions

Repair Description

Repair motor.

Replace equipment.

Long Lead Time (Yes / No) NO YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.40E+03	4.00E+03	5.20E+03	2.49E+04	3.00E+04	3.99E+04									
Best fit mean:	4.13E+03			3.10E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00											
Average Repair Cost (Min Qty, Max Qty)	4.40E+03 3.60E+03			3.30E+04 2.70E+04											
CV or beta (Min Qty, Max Qty)	0.17 0.17			0.19 0.19											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	4.00E+00	4.71E+00	6.12E+00	8.77E+00	1.06E+01	1.41E+01									
Best fit mean:	4.71E+00			1.06E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00											
Average Repair Time (Min Qty, Max Qty)	5.18E+00 4.24E+00			1.41E+01 7.06E+00											
CV or beta (Min Qty, Max Qty)	0.30 0.30			0.31 0.31											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.8E+03	LogNormal	0.30	1.4E+04	LogNormal	0.31									
Embodied Energy (MJ)	2.1E+04	LogNormal	0.30	1.6E+05	LogNormal	0.31									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

D3032.0131

Line 506

NISTIR Name	Description

Compressor - Capacity: Large medical quality air supply - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined and
Costing is per unit.

Construction Quality:	Normal - Designed for seismic loads but no special seismic certification
Seismic Installation Conditions:	Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

Fragility Unit of Measure:	EA 1				Allow sum by floor or building? BLDG Demand Location (floor above)? No
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Mutually Exclusive		Mutually Exclusive	Mutually Exclusive	Mutually Exclusive
DS Hierarchy	MutEx(DS1,DS2,DS3,DS4)				
Descriptions	Anchorage failure.	Anchorage failure & Equipment damaged beyond repair.	Motor damaged but anchorage is OK.	Equipment damaged beyond repair but anchorage is OK.	

Illustrations



D3032.011a-DS1-1.JPG

0.35

none
0,15

none
0.25

none
0.25

Damage State Probability:

0,35

0,15

0.25

0.25

Fragility Parameters

Median Demand, θ_d	By User	By User	By User	By User
Data dispersion, β_d	User to Calculate	User to Calculate	User to Calculate	User to Calculate
Uncertainty, β_u	User to Calculate	User to Calculate	User to Calculate	User to Calculate
Total Dispersion, β_t	By User	By User	By User	By User

Correlation (Yes / No)

NO

Data Quality: Average

Documentation Quality: Superior

Directionality (Yes / No)

NO

Data Relevance: Average

Rationality Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utility in addition to repairing anchorage and concrete pad.

Repair Motor - Anchorage and Concrete do not require repair.

Replace and install equipment including new anchorage if anchorage is post-installed.

Long Lead Time (Yes / No)

NO

YES

NO

YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	5.50E+02	8.50E+02	1.60E+03	2.54E+04	3.09E+04	4.15E+04	3.40E+03	4.00E+03	5.20E+03	2.54E+04	3.09E+04	4.15E+04			
Best fit mean:	8.98E+02			3.19E+04			4.13E+03			3.19E+04					
Best Fit Distribution:	LogNormal			LogNormal			LogNormal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00	1.00		5.00			
Average Repair Cost (Min Qty, Max Qty)	9.35E+02		7.65E+02	3.39E+04		2.78E+04	4.40E+03		3.60E+03	3.39E+04		2.78E+04			
CV or beta (Min Qty, Max Qty)	0.44		0.44	0.20		0.20	0.17		0.17	0.20		0.20			
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	6.47E-01	1.00E+00	1.88E+00	8.97E+00	1.09E+01	1.47E+01	4.00E+00	4.71E+00	6.12E+00	2.99E+01	3.63E+01	4.89E+01			
Best fit mean:	1.00E+00			1.09E+01			4.71E+00			3.63E+01					
Best Fit Distribution:	LogNormal			LogNormal			LogNormal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00	1.00		5.00			
Average Repair Time (Min Qty, Max Qty)	1.10E+00		9.00E-01	1.45E+01		7.26E+00	5.18E+00		4.24E+00	3.99E+01		3.27E+01			
CV or beta (Min Qty, Max Qty)	0.51		0.51	0.32		0.32	0.30		0.30	0.32		0.32			
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	9.1E+01	LogNormal	0.51	1.4E+04	LogNormal	0.32	1.8E+03	LogNormal	0.30	1.4E+04	LogNormal	0.32			
Embodied Energy (MJ)	2.6E+03	LogNormal	0.51	1.6E+05	LogNormal	0.32	2.1E+04	LogNormal	0.30	1.6E+05	LogNormal	0.32			
LifeSafety Hazard:	Potential non-collapse casualties? (Yes / No)			NO			NO			NO			NO		
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00				
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00				
Post-event Tagging Flag:	NO			NO			NO			NO					
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00				

Comments: User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Date Created:
Approved (YES / NO)?
Official (YES / NO) ?
Author:
Revisions:

Not Given
By User
By User
Not Given
None

Root Cost Multiplier: 1
Date Generated: 02/26/19

NISTIR Classification

Line 509

HVAC Fan In Line Fan, Fan independently supported and vibration isolators, SDC D, E, F
Costing per 10 units

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Fragility Unit of Measure:		EA 10		Allow sum by floor or building? NO	
Demand Parameter (unit):		Peak Floor Acceleration g		Demand Location (floor above?) Yes	
Number of Damage States:		2			
Damage State:		DS1		DS2	
Type of Damage State:		Sequential		Sequential	
DS Hierarchy		Seq(DS1,DS2)			
Descriptions		Bellows fails at fans.		Fan dislodges from isolators and drops.	

Illustrations

none	none			
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Damage State Probability:

Frailty Parameters	TC	TC			
Median Demand, θ :	2.25	2.6			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, δ :	0.4	0.4			

Correlation (Yes / No)	NO	Data Quality	Marginal	Documentation Quality	Marginal
Directionality (Yes / No)	NO	Data Relevance	Superior	Rationality	Marginal

Consequence Functions

[illegible]

Replace failed bellows.	Replace fan, isolators and section of ducting to which fan is connected.
-------------------------	--

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State: Best fit mean: Best Fit Distribution: Quantity Plateau (Min Qty, Max Qty) Average Repair Cost (Min Qty, Max Qty) CV or beta (Min Qty, Max Qty)	5.00E+03	7.00E+03	1.15E+04	2.50E+04	2.70E+04	3.15E+04												
Quantity Unit:																		
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State: Best fit mean: Best Fit Distribution: Quantity Plateau (Min Qty, Max Qty) Average Repair Time (Min Qty, Max Qty)	5.88E+00	8.24E+00	1.35E+01	8.82E+00	9.53E+00	1.11E+01												
CV or beta (Min Qty, Max Qty)																		
Quantity Unit:	10 Units						10 Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.6E+03	LogNormal	0.42	1.1E+04	LogNormal	0.27												
Embodied Energy (MJ)	1.9E+04	LogNormal	0.42	1.3E+05	LogNormal	0.27												
LifeSafety Hazard:																		
Potential non-collapse casualties? (Yes / No)	NO						YES											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable						10 SF											
Serious Injury (Median, Dispersion)	0% 0.00						10% 0.50											
Loss of Life (Median, Dispersion)	0% 0.00						5% 0.50											
Post-event Tagging Flag:	NO						NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00						0% 0.00											

Comments:	One failure is expected per 10 units.
Date Created:	Not Given
Approved (YES / NO)?	By User
Official (YES / NO) ?	By User
Author:	Not Given
Revisions:	None

Root Cost Multiplier: 10
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3041.002a

HVAC Fan In Line Fan, Fan independently supported but not on vibration isolators, SDC A or B

Costing per 10 units

Line 511

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

Normal - SDC A or B

EA 10

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Bellows fails at fans.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.9

Not Specified

Not Specified

0.4

NO

NO

Data Quality

Marginal

Documentation Quality

Marginal

Data Relevance

Superior

Rationality

Marginal

Consequence Functions

Repair Description

Replace failed bellows.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

5.00E+03

7.00E+03

1.15E+04

7.34E+03

LogNormal

1.00

5.00

7.70E+03

6.30E+03

0.34

0.34

10 Units

P₁₀

P₅₀

P₉₀

5.88E+00

8.24E+00

1.35E+01

8.24E+00

LogNormal

1.00

5.00

9.06E+00

7.41E+00

0.42

0.42

10 Units

Median Cost

Best Fit

CV or Beta

1.6E+03

LogNormal

0.42

1.9E+04

LogNormal

0.42

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

One failure is expected per 10 units.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

10

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3041.002b

HVAC Fan In Line Fan, Fan independently supported but not on vibration isolators, SDC C

Costing per 10 units

Line 512

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

Normal - SDC C

EA 10

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Bellows fails at fans.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

Damage State Probability:

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.9

Not Specified

Not Specified

0.4

NO

NO

Data Quality

Marginal

Documentation Quality

Marginal

Data Relevance

Superior

Rationality

Marginal

Consequence Functions

Repair Description

Replace failed bellows.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	5.00E+03	7.00E+03	1.15E+04												
Best fit mean:	7.34E+03														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Cost (Min Qty, Max Qty)	7.70E+03		6.30E+03												
CV or beta (Min Qty, Max Qty)	0.34		0.34												
Quantity Unit:	10 Units														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.88E+00	8.24E+00	1.35E+01												
Best fit mean:	8.24E+00														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Time (Min Qty, Max Qty)	9.06E+00		7.41E+00												
CV or beta (Min Qty, Max Qty)	0.42		0.42												
Quantity Unit:	10 Units														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.6E+03	LogNormal	0.42												
Embodied Energy (MJ)	1.9E+04	LogNormal	0.42												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

One failure is expected per 10 units.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

10

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3041.002c

HVAC Fan In Line Fan, Fan independently supported but not on vibration isolators, SDC D, E, F

Costing per 10 units

Line 513

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

Normal - SDC D, E or F

EA 10

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Bellows fails at fans.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

2.25

Not Specified

Not Specified

0.4

NO

NO

Data Quality

Marginal

Documentation Quality

Marginal

Data Relevance

Superior

Rationality

Marginal

Consequence Functions

Repair Description

Replace failed bellows.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

5.00E+03

7.00E+03

1.15E+04

7.34E+03

LogNormal

1.00

5.00

7.70E+03

6.30E+03

0.34

0.34

10 Units

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

5.88E+00

8.24E+00

1.35E+01

8.24E+00

LogNormal

1.00

5.00

9.06E+00

7.41E+00

0.42

0.42

10 Units

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Median Cost

Best Fit

CV or Beta

1.6E+03

LogNormal

0.42

Median Cost

Best Fit

CV or Beta

1.9E+04

LogNormal

0.42

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

One failure is expected per 10 units.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

10

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3041.002d

HVAC Fan In Line Fan, Fan independently supported but not on vibration isolators, SDC D, E, F (OSHDP or sim)

Costing per 10 units

Line 514

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Special Regulation (e.g. OSHPD) for HVAC installations

Special Regulation (e.g. OSHPD) for HVAC installations - SDC D, E or F (high seismic design)

EA 10

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Bellows fails at fans.

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	Yes	

Illustrations

none				
1.00				

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	2.25				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	Not Specified				
Total Dispersion, β :	0.4				
Correlation (Yes / No)	NO	Data Quality	Marginal	Documentation Quality	Marginal
Directionality (Yes / No)	NO	Data Relevance	Superior	Rationality	Marginal

Consequence Functions

Repair Description

Replace failed bellows.

Long Lead Time (Yes / No)NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	5.00E+03	7.00E+03	1.15E+04												
Best fit mean:	7.34E+03														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Cost (Min Qty, Max Qty)	7.70E+03		6.30E+03												
CV or beta (Min Qty, Max Qty)	0.34		0.34												
Quantity Unit:	10 Units														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.88E+00	8.24E+00	1.35E+01												
Best fit mean:	8.24E+00														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Time (Min Qty, Max Qty)	9.06E+00		7.41E+00												
CV or beta (Min Qty, Max Qty)	0.42		0.42												
Quantity Unit:	10 Units														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.6E+03	LogNormal	0.42												
Embodied Energy (MJ)	1.9E+04	LogNormal	0.42												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%		0.00												
Loss of Life (Median, Dispersion)	0%		0.00												
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00												

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

One failure is expected per 10 units.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

10

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3041.011a

HVAC Galvanized Sheet Metal Ducting less than 6 sq. ft in cross sectional area, SDC A or B

Costing based upon 1000 ft segments of duct

Line 515

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

Normal - SDC A or B

LF 1000

Peak Floor Acceleration

2

DS1

Sequential

Seq(DS1,DS2)

Individual supports fail and duct sags - 1 failed support per 1000 feet of ducting.

Several adjacent supports fail and sections of ducting fail - 60 feet of ducting fail and fall per 1000 foot of ducting.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.00

1.00

1.5

Not Specified

Not Specified

0.4

2.25

Not Specified

Not Specified

0.4

NO

NO

Data Quality

Marginal

Documentation Quality

Marginal

Data Relevance

Superior

Rationality

Marginal

Consequence Functions

Repair Description

Replace failed supports and repair ducting in vicinity of failed supports.

Replace sections of failed ducting and supports.

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	4.50E+02	6.50E+02	1.10E+03	5.75E+03	6.35E+03	7.40E+03									
Best fit mean:	6.81E+02			6.46E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00											
Average Repair Cost (Min Qty, Max Qty)	7.15E+02 5.85E+02			6.99E+03 5.72E+03											
CV or beta (Min Qty, Max Qty)	0.37 0.37			0.10 0.10											
Quantity Unit:	Each (1000 ft duct)			Each (1000 ft duct)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.29E-01	7.65E-01	1.29E+00	2.03E+00	2.24E+00	2.61E+00									
Best fit mean:	7.65E-01			2.24E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00											
Average Repair Time (Min Qty, Max Qty)	8.41E-01 6.88E-01			2.99E+00 1.49E+00											
CV or beta (Min Qty, Max Qty)	0.44 0.44			0.27 0.27											
Quantity Unit:	Each (1000 ft duct)			Each (1000 ft duct)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.8E+02	LogNormal	0.44	2.4E+03	LogNormal	0.27									
Embodied Energy (MJ)	2.7E+03	LogNormal	0.44	3.0E+04	LogNormal	0.27									
LifeSafety Hazard:	NO			YES											
Potential non-collapse casualties? (Yes / No)	NO			YES											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			15 SF											
Serious Injury (Median, Dispersion)	0% 0.00			5% 0.50											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3041.011b

HVAC Galvanized Sheet Metal Ducting less than 6 sq. ft in cross sectional area, SDC C

Costing based upon 1000 ft segments of duct

Line 516

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

Normal - SDC C

LF 1000

Peak Floor Acceleration

2

DS1

Sequential

Seq(DS1,DS2)

Individual supports fail and duct sags - 1 failed support per 1000 feet of ducting.

Several adjacent supports fail and sections of ducting fall - 60 feet of ducting fail and fall per 1000 foot of ducting.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

none

1.00

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.5

Not Specified

Not Specified

0.4

2.25

Not Specified

Not Specified

0.4

NO

NO

Data Quality

Marginal

Documentation Quality

Marginal

Data Relevance

Superior

Rationality

Marginal

Consequence Functions

Repair Description

Replace failed supports and repair ducting in vicinity of failed supports.

Replace sections of failed ducting and supports.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

4.50E+02

6.50E+02

1.10E+03

5.75E+03

6.35E+03

7.40E+03

6.81E+02

LogNormal

1.00

5.00

1.00

5.00

7.15E+02

5.85E+02

6.99E+03

5.72E+03

0.37

0.37

0.10

0.10

Each (1000 ft duct)

Each (1000 ft duct)

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

5.29E-01

7.65E-01

1.29E+00

2.03E+00

2.24E+00

2.61E+00

7.65E-01

LogNormal

1.00

5.00

1.00

5.00

8.41E-01

6.88E-01

2.99E+00

1.49E+00

0.44

0.44

0.27

0.27

Each (1000 ft duct)

Each (1000 ft duct)

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

1.8E+02

LogNormal

0.44

2.4E+03

LogNormal

0.27

2.7E+03

LogNormal

0.44

3.0E+04

LogNormal

0.27

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

15 SF

5%

0.50

0%

0.00

NO

0%

0.00

YES

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR ClassificationD3041.011c

NISTIR NameHVAC Galvanized Sheet Metal Ducting less than 6 sq. ft in cross sectional area, SDC D, E, or F

DescriptionCosting based upon 1000 ft segments of duct

Line 517

Construction Quality:Normal

Seismic Installation Conditions:Normal - SDC D, E or F

Quantity RoundingRound Qty?NO

Fragility Unit of Measure:LF 1000

Allow sum by floor or building?NO

Demand Parameter (unit):Peak Floor Accelerationg

Demand Location (floor above?)Yes

Number of Damage States:2

Damage State:DS1DS2

Type of Damage State:SequentialSequential

DS HierarchySeq(DS1,DS2)

DescriptionsIndividual supports fail and duct sags - 1
failed support per 1000 feet of ducting.
Several adjacent supports fail and
sections of ducting fail - 60 feet of
ducting fail and fall per 1000 foot of
ducting.

Illustrations

none

none

Damage State Probability:

1.001.00

Fragility Parameters

Median Demand, θ :1.52.25

Data dispersion, β_d :Not SpecifiedNot Specified

Uncertainty, β_u :Not SpecifiedNot Specified

Total Dispersion, β :0.40.4

Correlation (Yes / No)NO

Data Quality Marginal

Documentation Quality Marginal

Directionality (Yes / No)NO

Data Relevance Superior

Rationality Marginal

Consequence Functions

Repair Description

Replace failed supports and repair ducting in vicinity of failed supports.

Replace sections of failed ducting and supports.

Long Lead Time (Yes / No)NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	4.50E+02	6.50E+02	1.10E+03	5.75E+03	6.35E+03	7.40E+03									
Best fit mean:	6.81E+02			6.46E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.005.00			1.005.00											
Average Repair Cost (Min Qty, Max Qty)	7.15E+025.85E+02			6.99E+035.72E+03											
CV or beta (Min Qty, Max Qty)	0.370.37			0.100.10											
Quantity Unit:	Each (1000 ft duct)			Each (1000 ft duct)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.29E-01	7.65E-01	1.29E+00	2.03E+00	2.24E+00	2.61E+00									
Best fit mean:	7.65E-01			2.24E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.005.00			1.005.00											
Average Repair Time (Min Qty, Max Qty)	8.41E-016.88E-01			2.99E+001.49E+00											
CV or beta (Min Qty, Max Qty)	0.440.44			0.270.27											
Quantity Unit:	Each (1000 ft duct)			Each (1000 ft duct)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.8E+02	LogNormal	0.44	2.4E+03	LogNormal	0.27									
Embodied Energy (MJ)	2.7E+03	LogNormal	0.44	3.0E+04	LogNormal	0.27									
LifeSafety Hazard:	NO			YES											
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			15 SF											
Serious Injury (Median, Dispersion)	0%0.00			5%0.50											
Loss of Life (Median, Dispersion)	0%0.00			0%0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%0.00			0%0.00											

Comments:None

Date Created:Not Given

Approved (YES / NO)?By User

Official (YES / NO) ?By User

Author:Not Given

Revisions:None

Root Cost Multiplier:1

Date Generated:02/26/19

FEMA P-58 Fragility Specification

NISTIR ClassificationD3041.011d

NISTIR NameHVAC Galvanized Sheet Metal Ducting less than 6 sq. ft in cross sectional area, SDC D, E, or F (OSHPD or sim)

DescriptionCosting based upon 1000 ft segments of duct

Line 518

Construction Quality:Special Regulation (e.g. OSHPD) for HVAC ducting installation

Seismic Installation Conditions:Special Regulation (e.g. OSHPD) for HVAC ducting installation - SDC D, E or F (high seismic design)

Fragility Unit of Measure:LF 1000

Demand Parameter (unit):Peak Floor Accelerationg

Number of Damage States:2

Quantity RoundingRound Qty?NO

Allow sum by floor or building?NO

Demand Location (floor above?)Yes

Damage State:DS1DS2

Type of Damage State:SequentialSequential

DS HierarchySeq(DS1,DS2)

DescriptionsIndividual supports fail and duct sags - 1
failed support per 1000 feet of ducting.
Several adjacent supports fail and
sections of ducting fall - 60 feet of
ducting fail and fall per 1000 foot of
ducting.

Illustrations

none	none			
1.00	1.00			

Damage State Probability:

Fragility Parameters

Median Demand, θ :1.5

Data dispersion, β_d :Not Specified

Uncertainty, β_u :Not Specified

Total Dispersion, β :0.4

Correlation (Yes / No)NO

Directionality (Yes / No)NO

Data Quality Marginal

Data Relevance Superior

Documentation Quality Marginal

Rationality Marginal

Consequence Functions

Repair DescriptionReplace failed supports and repair ducting in
vicinity of failed supports.
Replace sections of failed ducting and
supports.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	4.50E+02	6.50E+02	1.10E+03	5.75E+03	6.35E+03	7.40E+03									
Best fit mean:	6.81E+02			6.46E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.005.00			1.005.00											
Average Repair Cost (Min Qty, Max Qty)	7.15E+025.85E+02			6.99E+035.72E+03											
CV or beta (Min Qty, Max Qty)	0.370.37			0.100.10											
Quantity Unit:	Each (1000 ft duct)			Each (1000 ft duct)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.29E-01	7.65E-01	1.29E+00	2.03E+00	2.24E+00	2.61E+00									
Best fit mean:	7.65E-01			2.24E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.005.00			1.005.00											
Average Repair Time (Min Qty, Max Qty)	8.41E-016.88E-01			2.99E+001.49E+00											
CV or beta (Min Qty, Max Qty)	0.440.44			0.270.27											
Quantity Unit:	Each (1000 ft duct)			Each (1000 ft duct)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.8E+02	LogNormal	0.44	2.4E+03	LogNormal	0.27									
Embodied Energy (MJ)	2.7E+03	LogNormal	0.44	3.0E+04	LogNormal	0.27									
LifeSafety Hazard:	NO			YES											
Potential non-collapse casualties? (Yes / No)	NO			YES											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			15 SF											
Serious Injury (Median, Dispersion)	0%0.00			5%0.50											
Loss of Life (Median, Dispersion)	0%0.00			0%0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%0.00			0%0.00											

Comments:None

Date Created:Not Given

Approved (YES / NO)?By User

Official (YES / NO) ?By User

Author:Not Given

Revisions:None

Root Cost Multiplier:1

Date Generated:02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3041.012a

HVAC Galvanized Sheet Metal Ducting - 6 sq. ft cross sectional area or greater, SDC A or B

Costing based upon 1000 ft segments of duct

Line 519

Construction Quality:	Normal					<div>Quantity RoundingRound Qty?NO</div> <div>Allow sum by floor or building?NO</div> <div>Demand Location (floor above)?Yes</div>
Seismic Installation Conditions:	Normal - SDC A or B					
Fragility Unit of Measure:	LF 1000					
Demand Parameter (unit):	Peak Floor Accelerationg					
Number of Damage States:	2					
Damage State:	DS1	DS2				
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Individual supports fail and duct sags - 1 failed support per 1000 feet of ducting. Several adjacent supports fail and sections of ducting fall - 60 feet of ducting fail and fall per 1000 foot of ducting.					

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	Yes	Yes

Illustrations

none	none			
1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	1.5	2.25			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO	Data Quality Marginal		Documentation Quality Marginal	
Directionality (Yes / No)	NO	Data Relevance Superior		Rationality Marginal	

Consequence Functions
Repair Description

Replace failed supports and repair ducting in vicinity of failed supports.

Replace sections of failed ducting and supports.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	7.50E+02	9.50E+02	1.40E+03	7.25E+03	7.95E+03	8.90E+03									
Best fit mean:	9.96E+02			8.00E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00											
Average Repair Cost (Min Qty, Max Qty)	1.05E+03 8.55E+02			8.75E+03 7.16E+03											
CV or beta (Min Qty, Max Qty)	0.26 0.26			0.08 0.08											
Quantity Unit:	Each (1000 ft duct)			Each (1000 ft duct)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.82E-01	1.12E+00	1.65E+00	2.56E+00	2.81E+00	3.14E+00									
Best fit mean:	1.12E+00			2.81E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00											
Average Repair Time (Min Qty, Max Qty)	1.23E+00 1.01E+00			3.74E+00 1.87E+00											
CV or beta (Min Qty, Max Qty)	0.36 0.36			0.26 0.26											
Quantity Unit:	Each (1000 ft duct)			Each (1000 ft duct)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	3.0E+02	LogNormal	0.36	2.9E+03	LogNormal	0.26									
Embodied Energy (MJ)	4.4E+03	LogNormal	0.36	3.8E+04	LogNormal	0.26									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			YES											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			50 SF											
Serious Injury (Median, Dispersion)	0% 0.00			10% 0.50											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3041.012b

HVAC Galvanized Sheet Metal Ducting - 6 sq. ft cross sectional area or greater, SDC C

Costing based upon 1000 ft segments of duct

Line 520

Construction Quality:	Normal					<div>Quantity Rounding</div> <div>Round Qty?</div> <div>NO</div> <div>Allow sum by floor or building?</div> <div>NO</div> <div>Demand Location (floor above?)</div> <div>Yes</div>
Seismic Installation Conditions:	Normal - SDC C					
Fragility Unit of Measure:	LF 1000					
Demand Parameter (unit):	Peak Floor Accelerationg					
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Individual supports fail and duct sags - 1 failed support per 1000 feet of ducting. Several adjacent supports fail and sections of ducting fail - 60 feet of ducting fail and fall per 1000 foot of ducting.					

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	Yes	Yes

Illustrations

none	none			
1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	1.5	2.25			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO	Data Quality Marginal		Documentation Quality Marginal	
Directionality (Yes / No)	NO	Data Relevance Superior		Rationality Marginal	

Consequence Functions

Repair Description

Replace failed supports and repair ducting in vicinity of failed supports.

Replace sections of failed ducting and supports.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	7.50E+02	9.50E+02	1.40E+03	7.25E+03	7.95E+03	8.90E+03									
Best fit mean:	9.96E+02			8.00E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00											
Average Repair Cost (Min Qty, Max Qty)	1.05E+03 8.55E+02			8.75E+03 7.16E+03											
CV or beta (Min Qty, Max Qty)	0.26 0.26			0.08 0.08											
Quantity Unit:	Each (1000 ft duct)			Each (1000 ft duct)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.82E-01	1.12E+00	1.65E+00	2.56E+00	2.81E+00	3.14E+00									
Best fit mean:	1.12E+00			2.81E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00											
Average Repair Time (Min Qty, Max Qty)	1.23E+00 1.01E+00			3.74E+00 1.87E+00											
CV or beta (Min Qty, Max Qty)	0.36 0.36			0.26 0.26											
Quantity Unit:	Each (1000 ft duct)			Each (1000 ft duct)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	3.0E+02	LogNormal	0.36	2.9E+03	LogNormal	0.26									
Embodied Energy (MJ)	4.4E+03	LogNormal	0.36	3.8E+04	LogNormal	0.26									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			YES											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			50 SF											
Serious Injury (Median, Dispersion)	0% 0.00			10% 0.50											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3041.012c

HVAC Galvanized Sheet Metal Ducting - 6 sq. ft cross sectional area or greater, SDC D, E, or F

Costing based upon 1000 ft segments of duct

Line 521

Construction Quality:	Normal					<div>Quantity Rounding</div> <div>Round Qty?</div> <div>NO</div> <div>Allow sum by floor or building?</div> <div>NO</div> <div>Demand Location (floor above?)</div> <div>Yes</div>
Seismic Installation Conditions:	Normal - SDC D, E or F					
Fragility Unit of Measure:	LF 1000					
Demand Parameter (unit):	Peak Floor Accelerationg					
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Individual supports fail and duct sags - 1 failed support per 1000 feet of ducting. Several adjacent supports fail and sections of ducting fall - 60 feet of ducting fail and fall per 1000 foot of ducting.					

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations

none	none			
1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	3.75	4.5			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO	Data Quality Marginal		Documentation Quality Marginal	
Directionality (Yes / No)	NO	Data Relevance Superior		Rationality Marginal	

Consequence Functions
Repair Description

Replace failed supports and repair ducting in vicinity of failed supports.

Replace sections of failed ducting and supports.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	7.50E+02	9.50E+02	1.40E+03	7.25E+03	7.95E+03	8.90E+03									
Best fit mean:	9.96E+02			8.00E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00											
Average Repair Cost (Min Qty, Max Qty)	1.05E+03 8.55E+02			8.75E+03 7.16E+03											
CV or beta (Min Qty, Max Qty)	0.26 0.26			0.08 0.08											
Quantity Unit:	Each (1000 ft duct)			Each (1000 ft duct)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.82E-01	1.12E+00	1.65E+00	2.56E+00	2.81E+00	3.14E+00									
Best fit mean:	1.12E+00			2.81E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00											
Average Repair Time (Min Qty, Max Qty)	1.23E+00 1.01E+00			3.74E+00 1.87E+00											
CV or beta (Min Qty, Max Qty)	0.36 0.36			0.26 0.26											
Quantity Unit:	Each (1000 ft duct)			Each (1000 ft duct)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	3.0E+02	LogNormal	0.36	2.9E+03	LogNormal	0.26									
Embodied Energy (MJ)	4.4E+03	LogNormal	0.36	3.8E+04	LogNormal	0.26									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			YES											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			50 SF											
Serious Injury (Median, Dispersion)	0% 0.00			10% 0.50											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3041.012d

HVAC Galvanized Sheet Metal Ducting - 6 sq. ft cross sectional area or greater, SDC D, E, or F (OSHDP or sim)

Costing based upon 1000 ft segments of duct

Line 522

Construction Quality:Special Regulation (e.g. OSHPD) for HVAC ducting installation

Seismic Installation Conditions:Special Regulation (e.g. OSHPD) for HVAC ducting installation - SDC D, E or F (high seismic design)

Fragility Unit of Measure:	LF 1000
Demand Parameter (unit):	Peak Floor Accelerationg
Number of Damage States:	2

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	Yes	Yes

Damage State:	DS1	DS2			
Type of Damage State:	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Individual supports fail and duct sags - 1 failed support per 1000 feet of ducting. Several adjacent supports fail and sections of ducting fall - 60 feet of ducting fail and fall per 1000 foot of ducting.				

Illustrations

none	none			
1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	3.75	4.5			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO	Data Quality Marginal		Documentation Quality Marginal	
Directionality (Yes / No)	NO	Data Relevance Superior		Rationality Marginal	

Consequence Functions

Repair Description

Replace failed supports and repair ducting in vicinity of failed supports.

Replace sections of failed ducting and supports.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	7.50E+02	9.50E+02	1.40E+03	7.25E+03	7.95E+03	8.90E+03									
Best fit mean:	9.96E+02			8.00E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.005.00			1.005.00											
Average Repair Cost (Min Qty, Max Qty)	1.05E+038.55E+02			8.75E+037.16E+03											
CV or beta (Min Qty, Max Qty)	0.260.26			0.080.08											
Quantity Unit:	Each (1000 ft duct)			Each (1000 ft duct)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.82E-01	1.12E+00	1.65E+00	2.56E+00	2.81E+00	3.14E+00									
Best fit mean:	1.12E+00			2.81E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.005.00			1.005.00											
Average Repair Time (Min Qty, Max Qty)	1.23E+001.01E+00			3.74E+001.87E+00											
CV or beta (Min Qty, Max Qty)	0.360.36			0.260.26											
Quantity Unit:	Each (1000 ft duct)			Each (1000 ft duct)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	3.0E+02	LogNormal	0.36	2.9E+03	LogNormal	0.26									
Embodied Energy (MJ)	4.4E+03	LogNormal	0.36	3.8E+04	LogNormal	0.26									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			YES											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			50 SF											
Serious Injury (Median, Dispersion)	0%0.00			10%0.50											
Loss of Life (Median, Dispersion)	0%0.00			0%0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%0.00			0%0.00											

Comments:None

Date Created:Not Given

Approved (YES / NO)?By User

Official (YES / NO) ?By User

Author:Not Given

Revisions:None

Root Cost Multiplier:1

Date Generated:02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification D3041.021b
NISTIR Name HVAC Stainless Steel Ducting less than 6 sq. ft in cross sectional area, SDC C
Description Costing based upon 1000 ft segments of duct

Line 524

Construction Quality:	Normal					<div>Quantity Rounding</div> <div>Round Qty?</div> <div>NO</div> <div>Allow sum by floor or building?</div> <div>NO</div> <div>Demand Location (floor above?)</div> <div>Yes</div>
Seismic Installation Conditions:	Normal - SDC C					
Fragility Unit of Measure:	LF 1000					
Demand Parameter (unit):	Peak Floor Accelerationg					
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Individual supports fail and duct sags - 1 failed support per 1000 feet of ducting. Several adjacent supports fail and sections of ducting fall - 60 feet of ducting fail and fall per 1000 foot of ducting.					

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	Yes	Yes

Illustrations

none	none			
1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	1.5	2.25			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO	Data Quality Marginal		Documentation Quality Marginal	
Directionality (Yes / No)	NO	Data Relevance Superior		Rationality Marginal	

Consequence Functions

Repair Description	Replace failed supports and repair ducting in vicinity of failed supports.	Replace sections of failed ducting and supports.
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Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.05E+03	1.25E+03	1.70E+03	1.28E+04	1.60E+04	2.04E+04									
Best fit mean:	1.31E+03			1.61E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00											
Average Repair Cost (Min Qty, Max Qty)	1.38E+03 1.13E+03			1.75E+04 1.44E+04											
CV or beta (Min Qty, Max Qty)	0.20 0.20			0.18 0.18											
Quantity Unit:	Each (1000 ft duct)			Each (1000 ft duct)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.24E+00	1.47E+00	2.00E+00	4.50E+00	5.63E+00	7.20E+00									
Best fit mean:	1.47E+00			5.63E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00											
Average Repair Time (Min Qty, Max Qty)	1.62E+00 1.32E+00			7.51E+00 3.75E+00											
CV or beta (Min Qty, Max Qty)	0.32 0.32			0.31 0.31											
Quantity Unit:	Each (1000 ft duct)			Each (1000 ft duct)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.7E+02	LogNormal	0.32	6.3E+03	LogNormal	0.31									
Embodied Energy (MJ)	6.1E+03	LogNormal	0.32	7.6E+04	LogNormal	0.31									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			YES											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			15 SF											
Serious Injury (Median, Dispersion)	0% 0.00			5% 0.50											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: None

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification D3041.021d

NISTIR Name HVAC Stainless Steel Ducting less than 6 sq. ft in cross sectional area, SDC D, E, or F (OSHDP or sim)

Description Costing based upon 1000 ft segments of duct

Line 526

Construction Quality: Special Regulation (e.g. OSHPD) for HVAC ducting installation

Seismic Installation Conditions: Special Regulation (e.g. OSHPD) for HVAC ducting installation - SDC D, E or F (high seismic design)

Fragility Unit of Measure:	LF 1000	Quantity Rounding	Round Qty?	NO
Demand Parameter (unit):	Peak Floor Acceleration g	Allow sum by floor or building?	NO	
Number of Damage States:	2	Demand Location (floor above?)	Yes	

Damage State:	DS1	DS2			
Type of Damage State:	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Individual supports fail and duct sags - 1 failed support per 1000 feet of ducting. Several adjacent supports fail and sections of ducting fall - 60 feet of ducting fail and fall per 1000 foot of ducting.				

Illustrations

none	none			
1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	1.5	2.25			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO	Data Quality Marginal		Documentation Quality Marginal	
Directionality (Yes / No)	NO	Data Relevance Superior		Rationality Marginal	

Consequence Functions

Repair Description

Replace failed supports and repair ducting in vicinity of failed supports.

Replace sections of failed ducting and supports.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.05E+03	1.25E+03	1.70E+03	1.28E+04	1.60E+04	2.04E+04									
Best fit mean:	1.31E+03			1.61E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00											
Average Repair Cost (Min Qty, Max Qty)	1.38E+03 1.13E+03			1.75E+04 1.44E+04											
CV or beta (Min Qty, Max Qty)	0.20 0.20			0.18 0.18											
Quantity Unit:	Each (1000 ft duct)			Each (1000 ft duct)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.16E+00	1.38E+00	1.88E+00	1.41E+01	1.76E+01	2.25E+01									
Best fit mean:	1.38E+00			1.76E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00											
Average Repair Time (Min Qty, Max Qty)	1.52E+00 1.24E+00			1.94E+01 1.58E+01											
CV or beta (Min Qty, Max Qty)	0.32 0.32			0.31 0.31											
Quantity Unit:	Each (1000 ft duct)			Each (1000 ft duct)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	4.7E+02	LogNormal	0.32	6.3E+03	LogNormal	0.31									
Embodied Energy (MJ)	6.1E+03	LogNormal	0.32	7.6E+04	LogNormal	0.31									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			YES											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			15 SF											
Serious Injury (Median, Dispersion)	0% 0.00			5% 0.50											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments: None

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Not Given

Revisions: None

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification D3041.022a
NISTIR Name HVAC Stainless Steel Ducting - 6 sq. ft cross sectional area or greater, SDC A or B
Description Costing based upon 1000 ft segments of duct

Line 527

Construction Quality:	Normal					<div>Quantity Rounding</div> <div>Round Qty?</div> <div>NO</div> <div>Allow sum by floor or building?</div> <div>NO</div> <div>Demand Location (floor above?)</div> <div>Yes</div>	
Seismic Installation Conditions:	Normal - SDC A or B						
Fragility Unit of Measure:	LF 1000						
Demand Parameter (unit):	Peak Floor Accelerationg						
Number of Damage States:	2						
Damage State:	DS1		DS2				
Type of Damage State:	Sequential		Sequential				
DS Hierarchy	Seq(DS1,DS2)						
Descriptions	Individual supports fail and duct sags - 1 failed support per 1000 feet of ducting. Several adjacent supports fail and sections of ducting fall - 60 feet of ducting fail and fall per 1000 foot of ducting.						

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	Yes	

Illustrations

none	none			
1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	1.5	2.25			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO	Data Quality Marginal		Documentation Quality Marginal	
Directionality (Yes / No)	NO	Data Relevance Superior		Rationality Marginal	

Consequence Functions
Repair Description

Replace failed supports and repair ducting in vicinity of failed supports.
Replace sections of failed ducting and supports.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.75E+03	1.95E+03	2.40E+03	1.93E+04	2.15E+04	2.69E+04									
Best fit mean:	2.02E+03			2.23E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00											
Average Repair Cost (Min Qty, Max Qty)	2.15E+03 1.76E+03			2.36E+04 1.93E+04											
CV or beta (Min Qty, Max Qty)	0.13 0.13			0.14 0.14											
Quantity Unit:	Each (1000 ft duct)			Each (1000 ft duct)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.93E+00	2.15E+00	2.65E+00	2.12E+01	2.37E+01	2.97E+01									
Best fit mean:	2.15E+00			2.37E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00											
Average Repair Time (Min Qty, Max Qty)	2.37E+00 1.94E+00			2.60E+01 2.13E+01											
CV or beta (Min Qty, Max Qty)	0.28 0.28			0.28 0.28											
Quantity Unit:	Each (1000 ft duct)			Each (1000 ft duct)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	7.8E+02	LogNormal	0.28	8.5E+03	LogNormal	0.28									
Embodied Energy (MJ)	1.0E+04	LogNormal	0.28	1.0E+05	LogNormal	0.28									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			YES											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			50 SF											
Serious Injury (Median, Dispersion)	0% 0.00			10% 0.50											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: None

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3041.022b

HVAC Stainless Steel Ducting - 6 sq. ft cross sectional area or greater, SDC C

Costing based upon 1000 ft segments of duct

Line 528

Construction Quality:	Normal					<div>Quantity Rounding</div> <div>Round Qty?</div> <div>NO</div> <div>Allow sum by floor or building?</div> <div>NO</div> <div>Demand Location (floor above?)</div> <div>Yes</div>
Seismic Installation Conditions:	Normal - SDC C					
Fragility Unit of Measure:	LF 1000					
Demand Parameter (unit):	Peak Floor Accelerationg					
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Individual supports fail and duct sags - 1 failed support per 1000 feet of ducting. Several adjacent supports fail and sections of ducting fall - 60 feet of ducting fail and fall per 1000 foot of ducting.					

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	Yes	Yes

Illustrations

none	none			
1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	1.5	2.25			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO	Data Quality Marginal		Documentation Quality Marginal	
Directionality (Yes / No)	NO	Data Relevance Superior		Rationality Marginal	

Consequence Functions
Repair Description

Replace failed supports and repair ducting in vicinity of failed supports.

Replace sections of failed ducting and supports.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.75E+03	1.95E+03	2.40E+03	1.93E+04	2.15E+04	2.69E+04									
Best fit mean:	2.02E+03			2.23E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00											
Average Repair Cost (Min Qty, Max Qty)	2.15E+03 1.76E+03			2.36E+04 1.93E+04											
CV or beta (Min Qty, Max Qty)	0.13 0.13			0.14 0.14											
Quantity Unit:	Each (1000 ft duct)			Each (1000 ft duct)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.93E+00	2.15E+00	2.65E+00	2.12E+01	2.37E+01	2.97E+01									
Best fit mean:	2.15E+00			2.37E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00											
Average Repair Time (Min Qty, Max Qty)	2.37E+00 1.94E+00			2.60E+01 2.13E+01											
CV or beta (Min Qty, Max Qty)	0.28 0.28			0.28 0.28											
Quantity Unit:	Each (1000 ft duct)			Each (1000 ft duct)											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	7.8E+02	LogNormal	0.28	8.5E+03	LogNormal	0.28									
Embodied Energy (MJ)	1.0E+04	LogNormal	0.28	1.0E+05	LogNormal	0.28									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			YES											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			50 SF											
Serious Injury (Median, Dispersion)	0% 0.00			10% 0.50											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3041.022c

HVAC Stainless Steel Ducting - 6 sq. ft cross sectional area or greater, SDC D, E, or F

Costing based upon 1000 ft segments of duct

Line 529

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

Normal - SDC D, E or F

LF 1000

Peak Floor Acceleration

2

DS1

Sequential

Seq(DS1,DS2)

Individual supports fail and duct sags - 1 failed support per 1000 feet of ducting.

Several adjacent supports fail and sections of ducting fall - 60 feet of ducting fail and fall per 1000 foot of ducting.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

none

1.00

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

3.75

Not Specified

Not Specified

0.4

4.5

Not Specified

Not Specified

0.4

NO

NO

Data Quality

Marginal

Documentation Quality

Marginal

Data Relevance

Superior

Rationality

Marginal

Consequence Functions

Repair Description

Replace failed supports and repair ducting in vicinity of failed supports.

Replace sections of failed ducting and supports.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

1.75E+03

1.95E+03

2.40E+03

P₁₀

P₅₀

P₉₀

2.02E+03

LogNormal

1.00

5.00

2.15E+03

1.76E+03

0.13

0.13

Each (1000 ft duct)

P₁₀

P₅₀

P₉₀

2.12E+01

2.37E+01

2.97E+01

P₁₀

P₅₀

P₉₀

2.15E+00

LogNormal

1.00

5.00

2.37E+00

1.94E+00

0.28

0.28

Each (1000 ft duct)

Median Cost

Best Fit

CV or Beta

7.8E+02

LogNormal

0.28

Median Cost

Best Fit

CV or Beta

8.5E+03

LogNormal

0.28

Median Cost

Best Fit

CV or Beta

1.0E+04

LogNormal

0.28

NO

YES

Not Applicable

50 SF

0%

0.00

10%

0.50

0%

0.00

0%

0.00

NO

NO

0%

0.00

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3041.022d

HVAC Stainless Steel Ducting - 6 sq. ft cross sectional area or greater, SDC D, E, or F (OSHPD or sim)

Costing based upon 1000 ft segments of duct

Line 530

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Special Regulation (e.g. OSHPD) for HVAC ducting installation

Special Regulation (e.g. OSHPD) for HVAC ducting installation - SDC D, E or F (high seismic design)

LF 1000

Peak Floor Acceleration

2

DS1

Sequential

Seq(DS1,DS2)

Individual supports fail and duct sags - 1 failed support per 1000 feet of ducting.

Several adjacent supports fail and sections of ducting fall - 60 feet of ducting fail and fall per 1000 foot of ducting.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

none

1.00

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

3.75

Not Specified

Not Specified

0.4

NO

NO

4.5

Not Specified

Not Specified

0.4

Data Quality Marginal

Data Relevance Superior

Documentation Quality Marginal

Rationality Marginal

Consequence Functions

Repair Description

Replace failed supports and repair ducting in vicinity of failed supports.

Replace sections of failed ducting and supports.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Time:

Environmental Impacts:

LifeSafety Hazard:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.75E+03

1.95E+03

2.40E+03

2.02E+03

LogNormal

1.00

5.00

2.15E+03

1.76E+03

0.13

0.13

Each (1000 ft duct)

P₁₀

P₅₀

P₉₀

1.93E+04

2.15E+04

2.69E+04

2.23E+04

LogNormal

1.00

5.00

2.36E+04

1.93E+04

0.14

0.14

Each (1000 ft duct)

P₁₀

P₅₀

P₉₀

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.93E+00

2.15E+00

2.65E+00

2.15E+00

LogNormal

1.00

5.00

2.37E+00

1.94E+00

0.28

0.28

Each (1000 ft duct)

P₁₀

P₅₀

P₉₀

2.12E+01

2.37E+01

2.97E+01

2.37E+01

LogNormal

1.00

5.00

2.60E+01

2.13E+01

0.28

0.28

Each (1000 ft duct)

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

7.8E+02

LogNormal

0.28

8.5E+03

LogNormal

0.28

1.0E+04

LogNormal

0.28

1.0E+05

LogNormal

0.28

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

NO

0%

0.00

YES

50 SF

10%

0.50

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3041.032a

HVAC Drops / Diffusers without ceilings - supported by ducting only - No independent safety wires, SDC A or B

Costing per 10 units, unit supported by ducting only, no independent safety wires

Line 533

Construction Quality:	Normal					Quantity Rounding		Round Qty?	NO
Seismic Installation Conditions:	Normal - SDC A or B					Allow sum by floor or building?		NO	
Fragility Unit of Measure:	EA 10					Demand Location (floor above?)		Yes	
Demand Parameter (unit):	Peak Floor Acceleration	g							
Number of Damage States:	1								
Damage State:	DS1								
Type of Damage State:	Sequential								
DS Hierarchy	Seq(DS1)								
Descriptions	HVAC drops or diffusers dislodges and falls.								

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	Yes	

Illustrations					
	none				
Damage State Probability:	1.00				

Fragility Parameters					
Median Demand, θ :	1.5				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	Not Specified				
Total Dispersion, β :	0.4				
Correlation (Yes / No)	NO	Data Quality	Marginal	Documentation Quality	Marginal
Directionality (Yes / No)	NO	Data Relevance	Superior	Rationality	Marginal

Consequence Functions

Repair Description

Replace diffuser/drop and sections of ceiling and ducting in vicinity to which diffuser/drop is connected.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.00E+03	3.00E+03	3.50E+03												
Best fit mean:	2.83E+03														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Cost (Min Qty, Max Qty)	3.30E+03		2.70E+03												
CV or beta (Min Qty, Max Qty)	0.21		0.21												
Quantity Unit:	10 Units														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.35E+00	3.53E+00	4.12E+00												
Best fit mean:	3.53E+00														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Time (Min Qty, Max Qty)	3.88E+00		3.18E+00												
CV or beta (Min Qty, Max Qty)	0.32		0.32												
Quantity Unit:	10 Units														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	7.3E+02	Normal	0.32												
Embodied Energy (MJ)	8.0E+03	Normal	0.32												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	YES														
Casualty-affected Planar Area (sf) per Normative Unit:	4 SF														
Serious Injury (Median, Dispersion)	10%	0.50													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

One failure is expected per 10 units.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

10

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3041.032b

HVAC Drops / Diffusers without ceilings - supported by ducting only - No independent safety wires, SDC C

Costing per 10 units, unit supported by ducting only, no independent safety wires

Line 534

Construction Quality:	Normal					Quantity Rounding		Round Qty?	NO
Seismic Installation Conditions:	Normal - SDC C					Allow sum by floor or building?		NO	
Fragility Unit of Measure:	EA 10					Demand Location (floor above?)		Yes	
Demand Parameter (unit):	Peak Floor Acceleration	g							
Number of Damage States:	1								
Damage State:	DS1								
Type of Damage State:	Sequential								
DS Hierarchy	Seq(DS1)								
Descriptions	HVAC drops or diffusers dislodges and falls.								

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	Yes	

Illustrations

none				
1.00				

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	1.5				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	Not Specified				
Total Dispersion, β :	0.4				
Correlation (Yes / No)	NO	Data Quality	Marginal	Documentation Quality	Marginal
Directionality (Yes / No)	NO	Data Relevance	Superior	Rationality	Marginal

Consequence Functions
Repair Description

Replace diffuser/drop and sections of ceiling and ducting in vicinity to which diffuser/drop is connected.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.00E+03	3.00E+03	3.50E+03												
Best fit mean:	2.83E+03														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Cost (Min Qty, Max Qty)	3.30E+03		2.70E+03												
CV or beta (Min Qty, Max Qty)	0.21		0.21												
Quantity Unit:	10 Units														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.35E+00	3.53E+00	4.12E+00												
Best fit mean:	3.53E+00														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Time (Min Qty, Max Qty)	3.88E+00		3.18E+00												
CV or beta (Min Qty, Max Qty)	0.32		0.32												
Quantity Unit:	10 Units														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	7.3E+02	Normal	0.32												
Embodied Energy (MJ)	8.0E+03	Normal	0.32												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	YES														
Casualty-affected Planar Area (sf) per Normative Unit:	4 SF														
Serious Injury (Median, Dispersion)	10%	0.50													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

One failure is expected per 10 units.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

10

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3041.032c

HVAC Drops / Diffusers without ceilings - supported by ducting only - No independent safety wires, SDC D, E, or F

Costing per 10 units, unit supported by ducting only, no independent safety wires

Line 535

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

Normal - SDC D, E or F

EA 10

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

HVAC drops or diffusers dislodges and falls.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.5

Not Specified

Not Specified

0.4

NO

NO

Data Quality

Marginal

Documentation Quality

Marginal

Data Relevance

Superior

Rationality

Marginal

Consequence Functions

Repair Description

Replace diffuser/drop and sections of ceiling and ducting in vicinity to which diffuser/drop is connected.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

2.00E+03

3.00E+03

3.50E+03

2.83E+03

Normal

5.00

2.70E+03

0.21

10 Units

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.35E+00

3.53E+00

4.12E+00

3.53E+00

Normal

5.00

3.18E+00

0.32

10 Units

Median Cost

Best Fit

CV or Beta

7.3E+02

Normal

0.32

0.32

Median Cost

Best Fit

CV or Beta

8.0E+03

Normal

0.32

0.00

YES

4 SF

10%

0%

NO

0%

0.50

0.00

0.00

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

One failure is expected per 10 units.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

10

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3041.032d

HVAC Drops / Diffusers without ceilings - supported by ducting only - No independent safety wires, SDC D, E, or F (OSHDP or sim)

Costing per 10 units, unit supported by ducting only, no independent safety wires

Line 536

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Special Regulation (e.g. OSHPD) for HVAC Ducting Installation

Special Regulation (e.g. OSHPD) for HVAC Ducting Installation - SDC D, E or F (high seismic design)

EA 10

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

HVAC drops or diffusers dislodges and falls.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.5

Not Specified

Not Specified

0.4

NO

NO

Data Quality

Marginal

Documentation Quality

Marginal

Data Relevance

Superior

Rationality

Marginal

Consequence Functions

Repair Description

Replace diffuser/drop and sections of ceiling and ducting in vicinity to which diffuser/drop is connected.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.00E+03

3.00E+03

3.50E+03

2.83E+03

Normal

1.00

5.00

3.30E+03

2.70E+03

0.21

0.21

10 Units

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.35E+00

3.53E+00

4.12E+00

3.53E+00

Normal

1.00

5.00

3.88E+00

3.18E+00

0.32

0.32

10 Units

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

7.3E+02

Normal

0.32

8.0E+03

Normal

0.32

YES

4 SF

10%

0.50

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

One failure is expected per 10 units.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

10

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3041.041a

Variable Air Volume (VAV) box with in-line coil, SDC A or B

Costing per 10 units

Line 537

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

Normal - SDC A or B

EA 10

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Coil damages connection to plumbing.

Leakage of hot water.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.9

Not Specified

Not Specified

0.4

NO

NO

Data Quality

Marginal

Documentation Quality

Marginal

Data Relevance

Superior

Rationality

Marginal

Consequence Functions

Repair Description

Replace coil and cleanup water damage.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.00E+04

1.50E+04

2.15E+04

1.48E+04

LogNormal

1.00

5.00

1.65E+04

1.35E+04

0.29

0.29

10 Units

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.18E+01

1.76E+01

2.53E+01

1.76E+01

LogNormal

1.00

5.00

1.94E+01

1.59E+01

0.39

0.39

10 Units

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

5.5E+03

LogNormal

0.39

6.5E+04

LogNormal

0.39

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

One failure is expected per 10 units.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

10

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3041.041b

Variable Air Volume (VAV) box with in-line coil, SDC C

Costing per 10 units

Line 538

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

Normal - SDC C

EA 10

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Coil damages connection to plumbing.

Leakage of hot water.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.9

Not Specified

Not Specified

0.4

NO

NO

Data Quality

Marginal

Documentation Quality

Marginal

Data Relevance

Superior

Rationality

Marginal

Consequence Functions

Repair Description

Replace coil and cleanup water damage.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

1.00E+04

1.50E+04

2.15E+04

1.48E+04

LogNormal

1.00

5.00

1.65E+04

1.35E+04

0.29

0.29

10 Units

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.18E+01

1.76E+01

2.53E+01

1.76E+01

LogNormal

1.00

5.00

1.94E+01

1.59E+01

0.39

0.39

10 Units

Median Cost

Best Fit

CV or Beta

5.5E+03

LogNormal

0.39

6.5E+04

LogNormal

0.39

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

One failure is expected per 10 units.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

10

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3041.101a

HVAC Fan - Capacity: all - Unanchored equipment that is not vibration isolated - Equipment fragility only

Costing is per unit.

Line 539

Construction Quality:Normal - Not designed for seismic loads

Seismic Installation Conditions:Unanchored equipment that is not vibration isolated

Frangility Unit of Measure:EA 1

Demand Parameter (unit):Peak Floor Accelerationg

Number of Damage States:1

Damage State:DS1

Type of Damage State:Sequential

DS HierarchySeq(DS1)


DescriptionsDamaged, inoperative.

Quantity RoundingRound Qty?NO

Allow sum by floor or building?BLDG

Demand Location (floor above?)No

Illustrations



D3041.101a-DS1-1.JPG

Damage State Probability:1.00

Frangility Parameters

Median Demand, θ :0.5

Data dispersion, β_d :0.4

Uncertainty, β_u :0.1

Total Dispersion, β :0.4

Correlation (Yes / No)NO

Directionality (Yes / No)NO

Consequence Functions

Repair DescriptionReplace equipment.

Data Quality Average

Documentation Quality Superior

Data Relevance Average

Rationality Superior

Long Lead Time (Yes / No) YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.20E+03	2.65E+03	3.15E+03												
Best fit mean:	2.64E+03														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Cost (Min Qty, Max Qty)	2.92E+03		2.39E+03												
CV or beta (Min Qty, Max Qty)	0.14		0.14												
Quantity Unit:	Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.59E+00	3.12E+00	3.71E+00												
Best fit mean:	3.12E+00														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Time (Min Qty, Max Qty)	3.43E+00		2.81E+00												
CV or beta (Min Qty, Max Qty)	0.29		0.29												
Quantity Unit:	Each														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	1.4E+03	LogNormal	0.29												
Embodied Energy (MJ)	1.7E+04	LogNormal	0.29												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments:None

Date Created:Not Given

Approved (YES / NO)?By User

Official (YES / NO) ?By User

Author:Not Given

Revisions:None

Root Cost Multiplier:1

Date Generated:02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3041.102a

HVAC Fan - Capacity: all - Vibration isolated equipment that is not snubbed or restrained - Anchorage fragility only

Costing is per unit.

Line 540

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

EA 1

Peak Floor Acceleration

2

DS1

Mutually Exclusive

MutEx(DS1.DS2)

Anchorage failure.

DS2

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D3041.101a-DS1-1.JPG

none

Damage State Probability:

0.70

0.30

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

By User

User to Calculate

User to Calculate

By User

NO

NO

By User

User to Calculate

User to Calculate

By User

Data Quality

Average

Documentation Quality

Superior

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and remount equipment.

Repair anchorage and replace equipment.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

5.00E+02

7.00E+02

1.15E+03

7.34E+02

LogNormal

1.00

5.00

7.70E+02

6.30E+02

0.34

0.34

Each

P₁₀

P₅₀

P₉₀

2.70E+03

3.35E+03

4.30E+03

3.39E+03

LogNormal

1.00

5.00

3.69E+03

3.02E+03

0.18

0.18

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

5.88E-01

8.24E-01

1.35E+00

8.24E-01

LogNormal

1.00

5.00

9.06E-01

7.41E-01

0.42

0.42

Each

P₁₀

P₅₀

P₉₀

3.18E-01

3.94E-01

5.06E-01

3.94E-01

LogNormal

1.00

5.00

7.88E-01

1.97E-01

0.31

0.31

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

1.0E+02

LogNormal

0.42

1.5E+03

LogNormal

0.31

3.1E+03

LogNormal

0.42

2.0E+04

LogNormal

0.31

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3041.102b

HVAC Fan - Capacity: all - Vibration isolated equipment that is not snubbed or restrained - Equipment fragility only

Costing is per unit.

Line 541

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

EA 1

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D3041.101a-DS1-1.JPG

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.00

1

0.6

0.1

0.6

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Replace equipment.

Long Lead Time (Yes / No)

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

2.20E+03

2.65E+03

3.15E+03

2.64E+03

LogNormal

1.00

5.00

2.92E+03

2.39E+03

0.14

0.14

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

2.59E+00

3.12E+00

3.71E+00

3.12E+00

LogNormal

1.00

5.00

3.43E+00

2.81E+00

0.29

0.29

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

1.4E+03

LogNormal

0.29

1.7E+04

LogNormal

0.29

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3041.103a

HVAC Fan - Capacity: all - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragility only

Costing is per unit.

Line 543

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

EA 1

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

Mutually Exclusive

MutEx(DS1.DS2)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D3041.101a-DS1-1.JPG

none

Damage State Probability:

0.70

0.30

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

NO

NO

Data Quality

Average

Documentation Quality

Superior

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and remount equipment.

Repair anchorage and replace equipment.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

5.00E+02

7.00E+02

1.15E+03

LogNormal

1.00

5.00

7.70E+02

6.30E+02

0.34

0.34

Each

P₁₀

P₅₀

P₉₀

2.70E+03

3.35E+03

4.30E+03

LogNormal

1.00

5.00

3.69E+03

3.02E+03

0.18

0.18

Each

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

5.88E-01

8.24E-01

1.35E+00

LogNormal

1.00

5.00

9.06E-01

7.41E-01

0.42

0.42

Each

P₁₀

P₅₀

P₉₀

3.18E-01

3.94E-01

5.06E-01

LogNormal

1.00

5.00

7.88E-01

1.97E-01

0.31

0.31

Each

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

1.0E+02

LogNormal

0.42

Median Cost

Best Fit

CV or Beta

1.5E+03

LogNormal

0.31

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3041.103b

HVAC Fan - Capacity: all - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragility only

Costing is per unit.

Line 544

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

EA 1

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D3041.101a-DS1-1.JPG

Damage State Probability:

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

4.8

0.6

0.1

0.6

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair equipment.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

2.20E+03

2.65E+03

3.15E+03

2.64E+03

LogNormal

1.00

5.00

2.92E+03

2.39E+03

0.14

0.14

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

2.59E+00

3.12E+00

3.71E+00

3.12E+00

LogNormal

1.00

5.00

3.43E+00

2.81E+00

0.29

0.29

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

1.4E+03

LogNormal

0.29

1.7E+04

LogNormal

0.29

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1


Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification	D3041.103c	Line 545
NISTIR Name	HVAC Fan - Capacity: all - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage/isolator & equipment fr	
Description	Costing is per unit.	

Construction Quality:	Normal - Designed for seismic loads but no special seismic certification			
Seismic Installation Conditions:	Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints			
Fragility Unit of Measure:	EA 1	Quantity Rounding Round Qty? NO		
Demand Parameter (unit):	Peak Floor Acceleration g	Allow sum by floor or building? BLDG		
Number of Damage States:	3	Demand Location (floor above?) No		
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive	
DS Hierarchy	MutEx(DS1,DS2,DS3)			
Descriptions	Anchorage failure.	Anchorage failure & Equipment damaged beyond repair.	Damaged, inoperative but anchorage is OK	

Illustrations					
	D3041.101a-DS1-1.JPG	none	none		
Damage State Probability:	0.35	0.15	0.50		
Fragility Parameters					
Median Demand, θ :	By User	By User	By User		
Data dispersion, β_d :	User to Calculate	User to Calculate	User to Calculate		
Uncertainty, β_u :	User to Calculate	User to Calculate	User to Calculate		
Total Dispersion, β :	By User	By User	By User		
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Superior	
Directionality (Yes / No)	NO	Data Relevance Average		Rationality Superior	
Consequence Functions					
Repair Description	Repair anchorage and remount equipment.	Repair anchorage and replace equipment.	Repair equipment.		

Long Lead Time (Yes / No)	NO	YES	NO		
Repair Costs:	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀
Repair Cost by Damage State:	5.00E+02 7.00E+02 1.15E+03	2.70E+03 3.35E+03 4.30E+03	2.20E+03 2.65E+03 3.15E+03		
Best fit mean:	7.34E+02	3.39E+03	2.64E+03		
Best Fit Distribution:	LogNormal	LogNormal	LogNormal		
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00	1.00 5.00	1.00 5.00		
Average Repair Cost (Min Qty, Max Qty)	7.70E+02 6.30E+02	3.69E+03 3.02E+03	2.92E+03 2.39E+03		
CV or beta (Min Qty, Max Qty)	0.34 0.34	0.18 0.18	0.14 0.14		
Quantity Unit:	Each	Each	Each		
Repair Time:	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀
Repair Time by Damage State:	5.88E-01 8.24E-01 1.35E+00	3.18E-01 3.94E-01 5.06E-01	2.59E+00 3.12E+00 3.71E+00		
Best fit mean:	8.24E-01	3.94E-01	3.12E+00		
Best Fit Distribution:	LogNormal	LogNormal	LogNormal		
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00	1.00 5.00	1.00 5.00		
Average Repair Time (Min Qty, Max Qty)	9.06E-01 7.41E-01	7.88E-01 1.97E-01	3.43E+00 2.81E+00		
CV or beta (Min Qty, Max Qty)	0.42 0.42	0.31 0.31	0.29 0.29		
Quantity Unit:	Each	Each	Each		
Environmental Impacts:	Median Cost Best Fit CV or Beta	Median Cost Best Fit CV or Beta	Median Cost Best Fit CV or Beta	Median Cost Best Fit CV or Beta	Median Cost Best Fit CV or Beta
Embodied Carbon (kg CO2eq)	1.0E+02 LogNormal 0.42	1.5E+03 LogNormal 0.31	1.4E+03 LogNormal 0.29		
Embodied Energy (MJ)	3.1E+03 LogNormal 0.42	2.0E+04 LogNormal 0.31	1.7E+04 LogNormal 0.29		
LifeSafety Hazard:					
Potential non-collapse casualties? (Yes / No)	NO	NO	NO		
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable	Not Applicable	Not Applicable		
Serious Injury (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00		
Loss of Life (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00		
Post-event Tagging Flag:	NO	NO	NO		
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00		

Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.	
Date Created:	Not Given	Root Cost Multiplier: 1
Approved (YES / NO)?	By User	Date Generated: 02/26/19
Official (YES / NO) ?	By User	
Author:	Not Given	
Revisions:	None	

FEMA P-58 Fragility Specification

NISTIR Classification

D3052.011a

NISTIR Name
Description

Air Handling Unit - Capacity: <5000 CFM - Unanchored equipment that is not vibration isolated - Equipment fragility only
Costing is per unit and is based upon 4000 CFM.

Line 546

Construction Quality:

Normal - Not designed for seismic loads

Seismic Installation Conditions:

Unanchored equipment that is not vibration isolated

Fragility Unit of Measure:

CF 4000

Demand Parameter (unit):

Peak Floor Acceleration g

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Mutually Exclusive

Mutually Exclusive

DS Hierarchy

MutEx(DS1.DS2)

Descriptions

Equipment does not function. Damage to attached ducting or piping.

Equipment does not function Equipment damaged beyond repair.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?	BLDG	
Demand Location (floor above?)	No	

Illustrations

				
D3052.011b-DS1-1.JPG	none			

Damage State Probability:

0.67

0.33

Fragility Parameters

Median Demand, θ :

0.25

0.25

Data dispersion, β_d :

0.4

0.40

Uncertainty, β_u :

0.1

0.1

Total Dispersion, β :

0.4

0.4

Correlation (Yes / No)

NO

Data Quality Average

Documentation Quality Superior

Directionality (Yes / No)

NO

Data Relevance Average

Rationality Superior

Consequence Functions

Repair Description

Repair attached ducting or piping.

Replace equipment. Remove, repair offsite, and reinstall air handler.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	9.00E+02	1.00E+03	1.30E+03	2.51E+04	2.92E+04	3.78E+04									
Best fit mean:	1.05E+03			3.02E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00			5.00											
Average Repair Cost (Min Qty, Max Qty)	1.10E+03			9.00E+02			3.21E+04			2.63E+04					
CV or beta (Min Qty, Max Qty)	0.15			0.15			0.17			0.17					
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	3.18E-01	3.53E-01	4.59E-01	5.91E+00	6.87E+00	8.89E+00									
Best fit mean:	3.53E-01			6.87E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00			5.00			1.00			5.00					
Average Repair Time (Min Qty, Max Qty)	4.71E-01			2.35E-01			1.03E+01			3.44E+00					
CV or beta (Min Qty, Max Qty)	0.29			0.29			0.30			0.30					
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	7.1E+01	LogNormal	0.29	1.6E+04	LogNormal	0.30									
Embodied Energy (MJ)	1.3E+03	LogNormal	0.29	1.9E+05	LogNormal	0.30									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%			0%			0%			0%					
Loss of Life (Median, Dispersion)	0%			0%			0%			0%					
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%			0%			0%			0%					

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2016-10-25 - Clarified repair.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3052.011b

Air Handling Unit - Capacity: 5000 to <10000 CFM - Unanchored equipment that is not vibration isolated - Equipment fragility only

Costing is per unit and is based upon 8000 CFM.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Unanchored equipment that is not vibration isolated

CF 8000

Peak Floor Acceleration

2

DS1

DS2

Mutually Exclusive

Mutually Exclusive

MutEx(DS1.DS2)

Equipment does not function. Damage to attached ducting or piping.

Equipment does not function Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D3052.011b-DS1-1.JPG

none

0.67

0.33

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

0.25

0.4

0.1

0.4

Correlation (Yes / No)

Directionality (Yes / No)

NO

NO

Data Quality

Average

Documentation Quality

Superior

Rationality

Superior

Consequence Functions

Repair Description

Repair attached ducting or piping.

Replace equipment. Remove, repair offsite, and reinstall air handler.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.30E+03

1.50E+03

2.00E+03

P₁₀

P₅₀

P₉₀

5.05E+04

5.90E+04

7.73E+04

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

4.59E-01

5.29E-01

7.06E-01

P₁₀

P₅₀

P₉₀

8.91E+00

1.04E+01

1.36E+01

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

1.1E+02

LogNormal

0.31

Median Cost

Best Fit

CV or Beta

3.3E+04

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2016-10-25 - Clarified repair.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3052.011c

Air Handling Unit - Capacity: 10000 to <25000 CFM - Unanchored equipment that is not vibration isolated - Equipment fragility only

Costing is per unit and is based upon 20000 CFM.

Line 548

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Unanchored equipment that is not vibration isolated

CF 20000

Peak Floor Acceleration

2

DS1

DS2

Mutually Exclusive

Mutually Exclusive

MutEx(DS1.DS2)

Equipment does not function. Damage to attached ducting or piping.

Equipment does not function Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D3052.011b-DS1-1.JPG

none

Damage State Probability:

0.67

0.33

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

0.25

0.4

0.1

0.4

Correlation (Yes / No)

NO

Data Quality

Average

Documentation Quality

Superior

Directionality (Yes / No)

NO

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair attached ducting or piping.

Replace equipment. Remove, repair offsite, and reinstall air handler.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.70E+03

2.00E+03

2.60E+03

LogNormal

1.00

5.00

2.20E+03

1.80E+03

0.17

0.17

Each

P₁₀

P₅₀

P₉₀

1.06E+05

1.25E+05

1.64E+05

LogNormal

1.00

5.00

1.38E+05

1.13E+05

0.17

0.17

Each

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

2.00E+00

2.35E+00

3.06E+00

LogNormal

1.00

5.00

2.59E+00

2.12E+00

0.30

0.30

Each

P₁₀

P₅₀

P₉₀

1.25E+01

1.47E+01

1.92E+01

LogNormal

1.00

5.00

2.95E+01

7.36E+00

0.30

0.30

Each

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

1.4E+02

LogNormal

0.30

6.9E+04

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

2.7E+03

LogNormal

0.30

8.1E+05

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2016-10-25 - Clarified repair.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3052.011d

Air Handling Unit - Capacity: 25000 to <40000 CFM - Unanchored equipment that is not vibration isolated - Equipment fragility only

Costing is per unit and is based upon 30000 CFM.

Line 549

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Unanchored equipment that is not vibration isolated

CF 30000

Peak Floor Acceleration

2

DS1

Mutually Exclusive

MutEx(DS1.DS2)

Equipment does not function. Damage to attached ducting or piping.

Equipment does not function Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D3052.011b-DS1-1.JPG

none

Damage State Probability:

0.67

0.33

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

0.25

0.4

0.1

0.4

0.25

0.40

0.1

0.4

Correlation (Yes / No)

NO

Data Quality

Average

Documentation Quality

Superior

Directionality (Yes / No)

NO

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair attached ducting or piping.

Replace equipment. Remove, repair offsite, and reinstall air handler.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.70E+03

2.00E+03

2.60E+03

2.07E+03

LogNormal

1.00

5.00

2.20E+03

1.80E+03

0.17

0.17

Each

P₁₀

P₅₀

P₉₀

1.58E+05

1.86E+05

2.43E+05

1.92E+05

LogNormal

1.00

5.00

2.05E+05

1.67E+05

0.17

0.17

Each

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

2.00E+00

2.35E+00

3.06E+00

2.35E+00

LogNormal

1.00

5.00

2.59E+00

2.12E+00

0.30

0.30

Each

P₁₀

P₅₀

P₉₀

1.30E+01

1.53E+01

2.00E+01

1.53E+01

LogNormal

1.00

5.00

3.72E+01

7.66E+00

0.30

0.30

Each

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

1.4E+02

LogNormal

0.30

1.0E+05

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

2.7E+03

LogNormal

0.30

1.2E+06

LogNormal

0.30

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2016-10-25 - Clarified repair.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3052.013a

Air Handling Unit - Capacity: <5000 CFM - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragility only

Costing is per unit and is based upon 4000 CFM.

Line 550

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

CF 4000

Peak Floor Acceleration

2

DS1

Mutually Exclusive

MutEx(DS1.DS2)

Anchorage failure.

DS2

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D3052.011c-DS1-1.JPG

none

0.30

Damage State Probability:

0.70

0.30

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

By User

User to Calculate

User to Calculate

By User

NO

NO

Data Quality

Average

Data Relevance

Average

Documentation Quality

Superior

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Remove, repair offsite, and reinstall air handler.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

5.00E+02

1.00E+03

1.70E+03

2.56E+04

3.02E+04

3.95E+04

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

5.88E-01

1.18E+00

2.00E+00

6.02E+00

7.11E+00

9.29E+00

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

1.1E+02

LogNormal

0.52

1.6E+04

LogNormal

0.31

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

2016-10-25 - Clarified repair.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3052.013b

Air Handling Unit - Capacity: <5000 CFM - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragility only

Costing is per unit and is based upon 4000 CFM.

Line 551

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

CF 4000

Peak Floor Acceleration

2

DS1

DS2

Mutually Exclusive

MutEx(DS1.DS2)

Equipment does not function but anchorage is OK. Damage to attached ducting or piping.

Equipment does not function but anchorage is OK. Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D3052.011b-DS1-1.JPG

none

0.67

0.33

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

1.54

0.6

0.1

0.6

1.54

0.60

0.1

0.6

Correlation (Yes / No)

NO

Data Quality

Average

Documentation Quality

Superior

Directionality (Yes / No)

NO

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair attached ducting or piping.

Replace equipment. Remove, repair offsite, and reinstall air handler.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

9.00E+02

1.00E+03

1.30E+03

1.05E+03

LogNormal

1.00

5.00

1.10E+03

9.00E+02

0.15

0.15

Each

P₁₀

P₅₀

P₉₀

2.51E+04

2.92E+04

3.78E+04

3.02E+04

LogNormal

1.00

5.00

3.21E+04

2.63E+04

0.17

0.17

Each

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

3.18E-01

3.53E-01

4.59E-01

3.53E-01

LogNormal

1.00

5.00

4.71E-01

2.35E-01

0.29

0.29

Each

P₁₀

P₅₀

P₉₀

5.91E+00

6.87E+00

8.89E+00

6.87E+00

LogNormal

1.00

5.00

1.03E+01

3.44E+00

0.30

0.30

Each

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

7.1E+01

LogNormal

0.29

1.6E+04

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

1.3E+03

LogNormal

0.29

1.9E+05

LogNormal

0.30

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2016-10-25 - Clarified repair.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

D3052.013c

Line 552

NISTIR Name
Description

Air Handling Unit - Capacity: <5000 CFM - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage/isolato
Costing is per unit and is based upon 4000 CFM.

Construction Quality: Normal - Designed for seismic loads but no special seismic certification
Seismic Installation Conditions: Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

Fragility Unit of Measure:	CF 4000
Demand Parameter (unit):	Peak Floor Acceleration g
Number of Damage States:	4

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?	BLDG	
Demand Location (floor above?)	No	

Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive	
DS Hierarchy	MutEx(DS1,DS2,DS3,DS4)				
Descriptions	Anchorage failure.	Anchorage failure & Equipment damaged beyond repair.	Damage to attached ducting or piping but anchorage is OK.	Equipment damaged beyond repair but anchorage is OK.	

Illustrations

				
D3052.011a-DS1-1.JPG	none	D3052.011b-DS1-1.JPG	none	
0.35	0.15	0.35	0.15	

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	By User	By User	By User	By User	
Data dispersion, β_d :	User to Calculate	User to Calculate	User to Calculate	User to Calculate	
Uncertainty, β_u :	User to Calculate	User to Calculate	User to Calculate	User to Calculate	
Total Dispersion, β_t :	By User	By User	By User	By User	
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Superior	
Directionality (Yes / No)	NO	Data Relevance Average		Rationality Superior	

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.
Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Remove, repair offsite, and reinstall air handler.
Repair attached ducting or piping - equipment does not require replacement and anchorage does not require repair
Replace and install equipment including new anchorage if anchorage is post-installed.

Long Lead Time (Yes / No)

NO YES NO YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	5.00E+02	1.00E+03	1.70E+03	2.56E+04	3.02E+04	3.95E+04	9.00E+02	1.00E+03	1.30E+03	2.51E+04	2.92E+04	3.78E+04			
Best fit mean:	9.59E+02 LogNormal			3.12E+04 LogNormal			1.05E+03 LogNormal			3.02E+04 LogNormal					
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00			1.00 5.00			1.00 5.00					
Average Repair Cost (Min Qty, Max Qty)	1.10E+03 9.00E+02			3.32E+04 2.72E+04			1.10E+03 9.00E+02			3.21E+04 2.63E+04					
CV or beta (Min Qty, Max Qty)	0.45 0.45			0.18 0.18			0.15 0.15			0.17 0.17					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.88E-01	1.18E+00	2.00E+00	6.02E+00	7.11E+00	9.29E+00	2.12E-01	2.35E-01	3.06E-01	5.91E+00	6.87E+00	8.89E+00			
Best fit mean:	1.18E+00 LogNormal			7.11E+00 LogNormal			2.35E-01 LogNormal			6.87E+00 LogNormal					
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00			1.00 5.00			1.00 5.00					
Average Repair Time (Min Qty, Max Qty)	1.29E+00 1.06E+00			1.07E+01 3.55E+00			3.53E-01 1.18E-01			1.03E+01 3.44E+00					
CV or beta (Min Qty, Max Qty)	0.52 0.52			0.31 0.31			0.29 0.29			0.30 0.30					
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.1E+02	LogNormal	0.52	1.6E+04	LogNormal	0.31	7.1E+01	LogNormal	0.29	1.6E+04	LogNormal	0.30			
Embodied Energy (MJ)	3.2E+03	LogNormal	0.52	1.9E+05	LogNormal	0.31	1.3E+03	LogNormal	0.29	1.9E+05	LogNormal	0.30			
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			NO			NO			NO					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					

Comments: User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2016-10-25 - Clarified repair.
Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3052.013d

Air Handling Unit - Capacity: 5000 to <10000 CFM - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragility
Costing is per unit and is based upon 8000 CFM.

Line 553

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification
Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints
CF 8000
Peak Floor Acceleration g
2
DS1DS2
Mutually Exclusive
MutEx(DS1.DS2)
Anchorage failure.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations



Damage State Probability:

0.70

0.30

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

By User
User to Calculate
User to Calculate
By User

By User
User to Calculate
User to Calculate
By User

Correlation (Yes / No)

NO

Data Quality

Average

Documentation Quality

Superior

Directionality (Yes / No)

NO

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair anchor and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Remove, repair offsite, and reinstall air handler.

Long Lead Time (Yes / No)NOYES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	8.00E+02	1.50E+03	2.40E+03	5.13E+04	6.05E+04	7.97E+04									
Best fit mean:	1.57E+03 Normal			6.27E+04 LogNormal											
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	1.00			1.00											
Average Repair Cost (Min Qty, Max Qty)	1.65E+03			6.66E+04											
CV or beta (Min Qty, Max Qty)	0.40			0.18											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.41E-01	1.76E+00	2.82E+00	9.05E+00	1.07E+01	1.41E+01									
Best fit mean:	1.76E+00 Normal			1.07E+01 LogNormal											
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	1.00			1.00											
Average Repair Time (Min Qty, Max Qty)	1.94E+00			1.78E+01											
CV or beta (Min Qty, Max Qty)	0.47			0.31											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.7E+02	Normal	0.47	3.3E+04	LogNormal	0.31									
Embodied Energy (MJ)	5.0E+03	Normal	0.47	3.8E+05	LogNormal	0.31									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:															
Unsafe Placard Trigger (Median, Dispersion)	NO			NO											
	0% 0.00			0% 0.00											

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.
Not Given
By User
By User
Not Given
2016-10-25 - Clarified repair.

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3052.013e

Air Handling Unit - Capacity: 5000 to <10000 CFM - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragility

Costing is per unit and is based upon 8000 CFM.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

CF 8000

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

Mutually Exclusive

MutEx(DS1.DS2)

Equipment does not function but anchorage is OK. Damage to attached ducting or piping.

Equipment does not function but anchorage is OK. Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations



D3052.011b-DS1-1.JPG

none

Damage State Probability:

0.67

0.33

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

1.54

0.6

0.1

0.6

1.54

0.60

0.1

0.6

Correlation (Yes / No)

NO

Data Quality

Average

Documentation Quality

Superior

Directionality (Yes / No)

NO

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair attached ducting or piping.

Replace equipment. Remove, repair offsite, and reinstall air handler.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P10

P50

P90

1.30E+03

1.50E+03

2.00E+03

1.57E+03

LogNormal

1.00

5.00

1.65E+03

1.35E+03

6.49E+04

5.31E+04

0.18

0.18

Each

P10

P50

P90

5.05E+04

5.90E+04

7.73E+04

6.12E+04

LogNormal

1.00

5.00

6.49E+04

5.31E+04

0.17

0.17

Each

P10

P50

P90

P10

P50

P90

P10

P50

P90

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P10

P50

P90

4.59E-01

5.29E-01

7.06E-01

5.29E-01

LogNormal

1.00

5.00

7.06E-01

3.53E-01

1.74E+01

5.21E+00

0.31

0.31

Each

P10

P50

P90

8.91E+00

1.04E+01

1.36E+01

1.04E+01

LogNormal

1.00

5.00

1.74E+01

5.21E+00

0.30

0.30

Each

P10

P50

P90

P10

P50

P90

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

1.1E+02

LogNormal

0.31

3.3E+04

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

2.0E+03

LogNormal

0.31

3.8E+05

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2016-10-25 - Clarified repair.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3052.013f

Air Handling Unit - Capacity: 5000 to <10000 CFM - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage

Costing is per unit and is based upon 8000 CFM.

Line 555

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

CF 8000

Peak Floor Acceleration

g

4

DS1

Mutually Exclusive

MutEx(DS1,DS2,DS3,DS4)

Anchorage failure.

DS2

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

DS3

Mutually Exclusive

Damage to attached ducting or piping but anchorage is OK.

DS4

Mutually Exclusive

Equipment damaged beyond repair but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D3052.011a-DS1-1.JPG

none

D3052.011b-DS1-1.JPG

none

Damage State Probability:

0.35

0.15

0.35

0.15

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

By User

User to Calculate

User to Calculate

By User

NO

NO

By User

User to Calculate

User to Calculate

By User

Data Quality

Average

By User

User to Calculate

User to Calculate

By User

Data Relevance

Average

By User

User to Calculate

User to Calculate

By User

Documentation Quality

Superior

By User

User to Calculate

User to Calculate

By User

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Remove, repair offsite, and reinstall air handler.

Repair attached ducting or piping - equipment does not require replacement and anchorage does not require repair

Replace and install equipment including new anchorage if anchorage is post-installed.

Long Lead Time (Yes / No)

NO

YES

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

8.00E+02

1.50E+03

2.40E+03

Normal

1.00

5.00

1.65E+03

1.35E+03

0.40

0.40

Each

P₁₀

P₅₀

P₉₀

5.13E+04

6.05E+04

7.97E+04

LogNormal

1.00

5.00

6.66E+04

5.45E+04

0.18

0.18

Each

P₁₀

P₅₀

P₉₀

1.30E+03

1.50E+03

2.00E+03

LogNormal

1.00

5.00

1.65E+03

1.35E+03

0.18

0.18

Each

P₁₀

P₅₀

P₉₀

5.05E+04

5.90E+04

7.73E+04

LogNormal

1.00

5.00

6.49E+04

5.31E+04

0.17

0.17

Each

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

9.41E-01

1.76E+00

2.82E+00

Normal

1.00

5.00

1.94E+00

1.59E+00

0.47

0.47

Each

P₁₀

P₅₀

P₉₀

9.05E+00

1.07E+01

1.41E+01

LogNormal

1.00

5.00

1.78E+01

5.34E+00

0.31

0.31

Each

P₁₀

P₅₀

P₉₀

3.06E-01

3.53E-01

4.71E-01

LogNormal

1.00

5.00

5.29E-01

1.76E-01

0.31

0.31

Each

P₁₀

P₅₀

P₉₀

8.91E+00

1.04E+01

1.36E+01

LogNormal

1.00

5.00

1.74E+01

5.21E+00

0.30

0.30

Each

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

1.7E+02

Normal

0.47

Median Cost

Best Fit

CV or Beta

3.3E+04

LogNormal

0.31

Median Cost

Best Fit

CV or Beta

1.1E+02

LogNormal

0.31

Median Cost

Best Fit

CV or Beta

3.3E+04

LogNormal

0.30

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

2016-10-25 - Clarified repair.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3052.013g

Air Handling Unit - Capacity: 10000 to <25000 CFM - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragility

Line 556

Costing is per unit and is based upon 20000 CFM.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

CF 20000

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

Mutually Exclusive

MutEx(DS1.DS2)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations



Damage State Probability:

0.70

0.30

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Remove, repair offsite, and reinstall air handler.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.40E+03	2.20E+03	3.10E+03	1.08E+05	1.27E+05	1.67E+05									
Best fit mean:	2.23E+03			1.32E+05											
Best Fit Distribution:	Normal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00			5.00											
Average Repair Cost (Min Qty, Max Qty)	2.42E+03			1.98E+03			1.40E+05			1.15E+05					
CV or beta (Min Qty, Max Qty)	0.30			0.30			0.18			0.18					
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	4.94E-01	7.77E-01	1.09E+00	1.27E+01	1.50E+01	1.96E+01									
Best fit mean:	7.77E-01			1.50E+01											
Best Fit Distribution:	Normal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00			5.00			1.00			5.00					
Average Repair Time (Min Qty, Max Qty)	1.04E+00			5.18E-01			3.00E+01			7.49E+00					
CV or beta (Min Qty, Max Qty)	0.39			0.39			0.31			0.31					
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.5E+02	Normal	0.39	7.0E+04	LogNormal	0.31									
Embodied Energy (MJ)	7.4E+03	Normal	0.39	8.1E+05	LogNormal	0.31									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%			0%			0%			0%					
Loss of Life (Median, Dispersion)	0%			0%			0%			0%					
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%			0%											

Comments:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2016-10-25 - Clarified repair.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3052.013h

Air Handling Unit - Capacity: 10000 to <25000 CFM - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragility

Costing is per unit and is based upon 20000 CFM.

Line 557

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

CF 20000

Peak Floor Acceleration

2

DS1

DS2

Mutually Exclusive

MutEx(DS1.DS2)

Equipment does not function but anchorage is OK. Damage to attached ducting or piping.

Equipment does not function but anchorage is OK. Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D3052.011b-DS1-1.JPG

none

0.67

0.33

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

1.54

0.6

0.1

0.6

1.54

0.60

0.1

0.6

Correlation (Yes / No)

NO

Data Quality

Average

Documentation Quality

Superior

Directionality (Yes / No)

NO

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair attached ducting or piping.

Replace equipment. Remove, repair offsite, and reinstall air handler.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.70E+03

2.00E+03

2.60E+03

2.07E+03

LogNormal

1.00

5.00

2.20E+03

1.80E+03

0.17

0.17

Each

P₁₀

P₅₀

P₉₀

1.06E+05

1.25E+05

1.64E+05

1.29E+05

LogNormal

1.00

5.00

1.38E+05

1.13E+05

0.17

0.17

Each

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

2.00E+00

2.35E+00

3.06E+00

2.35E+00

LogNormal

1.00

5.00

2.59E+00

2.12E+00

0.30

0.30

Each

P₁₀

P₅₀

P₉₀

1.25E+01

1.47E+01

1.92E+01

1.47E+01

LogNormal

1.00

5.00

2.95E+01

7.36E+00

0.30

0.30

Each

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

1.4E+02

LogNormal

0.30

6.9E+04

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

2.7E+03

LogNormal

0.30

8.1E+05

LogNormal

0.30

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2016-10-25 - Clarified repair.

Root Cost Multiplier:

1

Date Generated:

02/26/19

Line 558

Air Handling Unit - Capacity: 10000 to <25000 CFM - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage
Costing is per unit and is based upon 20000 CFM.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		BLDG
Demand Location (floor above?)		No

Number of Damage States:	4			
Damage State:	DS1	DS2	DS3	DS4
Type of Damage State:	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive
DS Hierarchy	MutEx(DS1,DS2,DS3,DS4)			
Descriptions	Anchorage failure.	Damage failure & Equipment damaged beyond repair.	Damage to attached ducting or piping but anchorage is OK.	Equipment damaged beyond repair but anchorage is OK.

Illustrations



Damage State Probability:		0.35		0.15		0.35		0.15	
Frailty Parameters		By User User to Calculate User to Calculate By User	By User User to Calculate User to Calculate By User	By User User to Calculate User to Calculate By User	By User User to Calculate User to Calculate By User	By User User to Calculate User to Calculate By User			
Median Demand, θ :									
Data dispersion, β_d :									
Uncertainty, β_u :									
Total Dispersion, β:									
Correlation (Yes / No)	NO	Data Quality Average				Documentation Quality Superior			
Directionality (Yes / No)	NO	Data Relevance Average				Rationality Superior			

Consequence Functions	Repair Description

Repair anchorage and concrete pad and remount equipment.	Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Remove, repair offsite, and reinstall air handler.	Repair attached ducting or piping - equipment does not require replacement and anchorage does not require repair	Replace and install equipment including new anchorage if anchorage is post-installed.
--	--	--	---

Long Lead Time (Yes / No)

NO YES NO YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.40E+03	2.20E+03	3.10E+03	1.08E+05	1.27E+05	1.67E+05	1.70E+03	2.00E+03	2.60E+03	1.06E+05	1.25E+05	1.64E+05			
Best fit mean:	2.23E+03			1.32E+05			2.07E+03			1.29E+05					
Best Fit Distribution:	Normal			LogNormal			LogNormal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00	1.00		5.00			
Average Repair Cost (Min Qty, Max Qty)	2.42E+03		1.98E+03	1.40E+05		1.15E+05	2.20E+03		1.80E+03	1.38E+05		1.13E+05			
CV or beta (Min Qty, Max Qty)	0.30		0.30	0.18		0.18	0.17		0.17	0.17		0.17			
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.65E+00	2.59E+00	3.65E+00	1.27E+01	1.50E+01	1.96E+01	2.00E+00	2.35E+00	3.06E+00	1.25E+01	1.47E+01	1.92E+01			
Best fit mean:	2.59E+00			1.50E+01			2.35E+00			1.47E+01					
Best Fit Distribution:	Normal			LogNormal			LogNormal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00	1.00		5.00			
Average Repair Time (Min Qty, Max Qty)	2.85E+00		2.33E+00	3.00E+01		7.49E+00	2.59E+00		2.12E+00	2.95E+01		7.36E+00			
CV or beta (Min Qty, Max Qty)	0.39		0.39	0.31		0.31	0.30		0.30	0.30		0.30			
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.5E+02	Normal	0.39	7.0E+04	LogNormal	0.31	1.4E+02	LogNormal	0.30	6.9E+04	LogNormal	0.30			
Embodied Energy (MJ)	7.4E+03	Normal	0.39	8.1E+05	LogNormal	0.31	2.7E+03	LogNormal	0.30	8.1E+05	LogNormal	0.30			
LifeSafety Hazard:	Potential non-collapse casualties? (Yes / No)			Potential non-collapse casualties? (Yes / No)			Potential non-collapse casualties? (Yes / No)			Potential non-collapse casualties? (Yes / No)					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00				
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00				
Post-event Tagging Flag:	Unsafe Placard Trigger (Median, Dispersion)			Unsafe Placard Trigger (Median, Dispersion)			Unsafe Placard Trigger (Median, Dispersion)			Unsafe Placard Trigger (Median, Dispersion)					
	0%	0.00		0%	0.00		0%	0.00		0%	0.00				

Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.		
Date Created:	Not Given	Root Cost Multiplier:	1
Approved (YES / NO)?	By User	Date Generated:	02/26/19
Official (YES / NO) ?	By User		
Author:	Not Given		
Revisions:	2016-10-25 - Clarified repair.		

FEMA P-58 Fragility Specification

NISTIR Classification

D3052.013j

Line 559

NISTIR Name
Description

Air Handling Unit - Capacity: 25000 to <40000 CFM - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragility
Costing is per unit and is based upon 30000 CFM.

Construction Quality: Normal - Designed for seismic loads but no special seismic certification
Seismic Installation Conditions: Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

Fragility Unit of Measure:	CF 30000
Demand Parameter (unit):	Peak Floor Acceleration g
Number of Damage States:	2

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?	BLDG	
Demand Location (floor above?)	No	

Damage State:	DS1	DS2			
Type of Damage State:	Mutually Exclusive	Mutually Exclusive			
DS Hierarchy	MutEx(DS1.DS2)				
Descriptions	Anchorage failure.	Anchorage failure & Equipment damaged beyond repair.			

Illustrations

				
D3052.011c-DS1-1.JPG	none			

Damage State Probability:	0.70	0.30			
Fragility Parameters					
Median Demand, θ :	By User	By User			
Data dispersion, β_d :	User to Calculate	User to Calculate			
Uncertainty, β_u :	User to Calculate	User to Calculate			
Total Dispersion, β :	By User	By User			
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Superior	
Directionality (Yes / No)	NO	Data Relevance Average		Rationality Superior	

Consequence Functions
Repair Description

Repair anchorage and concrete pad and remount equipment.
Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Remove, repair offsite, and reinstall air handler.

Long Lead Time (Yes / No)

NO YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.60E+03	2.40E+03	3.40E+03	1.59E+05	1.88E+05	2.46E+05									
Best fit mean:	2.36E+03			1.95E+05											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00											
Average Repair Cost (Min Qty, Max Qty)	2.64E+03 2.16E+03			2.07E+05 1.70E+05											
CV or beta (Min Qty, Max Qty)	0.29 0.29			0.18 0.18											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.65E-01	8.47E-01	1.20E+00	1.31E+01	1.55E+01	2.03E+01									
Best fit mean:	8.47E-01			1.55E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00											
Average Repair Time (Min Qty, Max Qty)	1.13E+00 5.65E-01			3.77E+01 7.76E+00											
CV or beta (Min Qty, Max Qty)	0.38 0.38			0.31 0.31											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.5E+02	LogNormal	0.38	1.0E+05	LogNormal	0.31									
Embodied Energy (MJ)	7.4E+03	LogNormal	0.38	1.2E+06	LogNormal	0.31									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments: User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2016-10-25 - Clarified repair.
Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3052.013k

Air Handling Unit - Capacity: 25000 to <40000 CFM - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragility

Costing is per unit and is based upon 30000 CFM.

Line 560

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

CF 30000

Peak Floor Acceleration

2

DS1

DS2

Mutually Exclusive

MutEx(DS1.DS2)

Equipment does not function but anchorage is OK. Damage to attached ducting or piping.

Equipment does not function but anchorage is OK. Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D3052.011b-DS1-1.JPG

none

0.67

0.33

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

1.54

0.6

0.1

0.6

1.54

0.60

0.1

0.6

Correlation (Yes / No)

NO

Data Quality

Average

Documentation Quality

Superior

Directionality (Yes / No)

NO

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair attached ducting or piping.

Replace equipment. Remove, repair offsite, and reinstall air handler.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.70E+03

2.00E+03

2.60E+03

2.07E+03

LogNormal

1.00

5.00

2.20E+03

1.80E+03

0.17

0.17

Each

P₁₀

P₅₀

P₉₀

1.58E+05

1.86E+05

2.43E+05

1.92E+05

LogNormal

1.00

5.00

2.05E+05

1.67E+05

0.17

0.17

Each

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

2.00E+00

2.35E+00

3.06E+00

2.35E+00

LogNormal

1.00

5.00

2.59E+00

2.12E+00

0.30

0.30

Each

P₁₀

P₅₀

P₉₀

1.30E+01

1.53E+01

2.00E+01

1.53E+01

LogNormal

1.00

5.00

3.72E+01

7.66E+00

0.30

0.30

Each

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

1.4E+02

LogNormal

0.30

1.0E+05

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

1.2E+06

LogNormal

0.30

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2016-10-25 - Clarified repair.

Root Cost Multiplier:

1

Date Generated:

02/26/19

Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.		
Date Created:	Not Given	Root Cost Multiplier:	1
Approved (YES / NO)?	By User	Date Generated:	02/26/19
Official (YES / NO) ?	By User		
Author:	Not Given		
Revisions:	2016-10-25 - Clarified repair.		

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3067.011a

Control Panel - Capacity: all - Unanchored equipment that is not vibration isolated - Equipment fragility only

Costing is per unit.

Line 562

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Unanchored equipment that is not vibration isolated

EA 1

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D3067.011a-DS1-1.JPG

Damage State Probability:

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.69

0.4

0.1

0.4

NO

NO

Data Quality

Superior

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Replace some components (relays, circuit boards).

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

3.20E+03

4.15E+03

5.15E+03

4.17E+03

Normal

1.00

5.00

4.57E+03

3.74E+03

0.18

0.18

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

3.76E+00

4.88E+00

6.06E+00

4.88E+00

Normal

1.00

5.00

5.37E+00

4.39E+00

0.31

0.31

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

8.7E+02

Normal

0.31

1.6E+04

Normal

0.31

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description


D3067.012a

Control Panel - Capacity: all - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragility only

Costing is per unit.

Line 563

Construction Quality:	Normal - Designed for seismic loads but no special seismic certification				
Seismic Installation Conditions:	Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints				
Fragility Unit of Measure:	EA 1		Quantity Rounding		
Demand Parameter (unit):	Peak Floor Acceleration g		Round Qty? YES		
Number of Damage States:	2		Allow sum by floor or building? BLDG		
Damage State:	DS1	DS2	Demand Location (floor above?) No		
Type of Damage State:	Mutually Exclusive				
DS Hierarchy	MutEx(DS1.DS2)				
Descriptions	Anchorage failure.		Anchorage failure & Equipment damaged beyond repair.		

Illustrations					
	D3067.011a-DS1-1.JPG	none			
Damage State Probability:	0.70	0.30			
Fragility Parameters					
Median Demand, θ :	By User	By User			
Data dispersion, β_d :	User to Calculate	User to Calculate			
Uncertainty, β_u :	User to Calculate	User to Calculate			
Total Dispersion, β :	By User	By User			
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Superior	
Directionality (Yes / No)	NO	Data Relevance Average		Rationality Superior	
Consequence Functions					
Repair Description	Repair anchorage and concrete pad and remount equipment.	Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.			

Long Lead Time (Yes / No)	NO			NO														
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀			
Repair Cost by Damage State:	3.00E+02	5.00E+02	6.50E+02	3.50E+03	4.65E+03	5.80E+03												
Best fit mean:	4.83E+02			4.65E+03														
Best Fit Distribution:	Normal			Normal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00												
Average Repair Cost (Min Qty, Max Qty)	5.50E+02		4.50E+02	5.12E+03		4.19E+03												
CV or beta (Min Qty, Max Qty)	0.28		0.28	0.19		0.19												
Quantity Unit:	Each			Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀			
Repair Time by Damage State:	1.06E-01	1.77E-01	2.29E-01	4.12E+00	5.47E+00	6.82E+00												
Best fit mean:	1.77E-01			5.47E+00														
Best Fit Distribution:	Normal			Normal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00												
Average Repair Time (Min Qty, Max Qty)	2.35E-01		1.18E-01	6.02E+00		4.92E+00												
CV or beta (Min Qty, Max Qty)	0.38		0.38	0.32		0.32												
Quantity Unit:	Each			Each														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta			
Embodied Carbon (kg CO2eq)	6.5E+01	Normal	0.38	9.3E+02	Normal	0.32												
Embodied Energy (MJ)	1.9E+03	Normal	0.38	1.8E+04	Normal	0.32												
LifeSafety Hazard:																		
Potential non-collapse casualties? (Yes / No)	NO			NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00													
Post-event Tagging Flag:	NO			NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00													

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

1

02/26/19

Line 564

Control Panel - Capacity: all - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragility only
Costing is per unit.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		BLDG
Demand Location (floor above?)	No	

Illustrations



D3067.011a-DS1-1.JPG

Damage State Probability:

1.00

Fragility Parameters

Median Demand, θ :

3

Data dispersion β_2 :

04

Uncertainty, β :

0.1

Correlation (Yes / No)

NO

Data Quality: Superior

Documentation Quality: Superior

Directionality (Yes / No)

NO
NO

Data Quality	Superior
Data Relevance	Average

Documentation Quality Superior

Consequence Functions

Repair Description

Replace some components (relays, circuit boards).

Long Lead Time (Yes / No)

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.20E+03	4.15E+03	5.15E+03												
Best fit mean:	4.17E+03														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	1.00	5.00													
Average Repair Cost (Min Qty, Max Qty)	4.57E+03	3.74E+03													
CV or beta (Min Qty, Max Qty)	0.18	0.18													
Quantity Unit:	Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.13E+00	1.46E+00	1.82E+00												
Best fit mean:	1.46E+00														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	1.00	5.00													
Average Repair Time (Min Qty, Max Qty)	1.95E+00	9.76E-01													
CV or beta (Min Qty, Max Qty)	0.31	0.31													
Quantity Unit:	Each														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	8.7E+02	Normal	0.31												
Embodied Energy (MJ)	1.6E+04	Normal	0.31												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official

By User
By User

Author:
Revisions:

By G.
Not G.
None

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3067.012c

Control Panel - Capacity: all - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage/isolator & equipment

Costing is per unit.

Line 565

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

EA 1

Peak Floor Acceleration

g

3

DS1

Mutually Exclusive

MutEx(DS1.DS2,DS3)

Anchorage failure.

DS2

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

DS3

Mutually Exclusive

Damaged, Inoperative but anchorage is OK

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

0.35



D5010.011a-DS1-1.JPG

0.15

none

0.50

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

User to Calculate

By User

NO

NO

Data Quality Superior

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Replace some components (relays, circuit boards

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Time:

Environmental Impacts:

LifeSafety Hazard:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

3.00E+02

5.00E+02

6.50E+02

4.83E+02

Normal

1.00

5.00

5.50E+02

4.50E+02

0.28

0.28

Each

P₁₀

P₅₀

P₉₀

3.50E+03

4.65E+03

5.80E+03

4.65E+03

Normal

1.00

5.00

5.12E+03

4.19E+03

0.19

0.19

Each

P₁₀

P₅₀

P₉₀

3.20E+03

4.15E+03

5.15E+03

4.17E+03

Normal

1.00

5.00

4.57E+03

3.74E+03

0.18

0.18

Each

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.06E-01

1.77E-01

2.29E-01

1.77E-01

Normal

1.00

5.00

2.35E-01

1.18E-01

0.38

0.38

Each

P₁₀

P₅₀

P₉₀

4.12E+00

5.47E+00

6.82E+00

5.47E+00

Normal

1.00

5.00

6.02E+00

4.92E+00

0.32

0.32

Each

P₁₀

P₅₀

P₉₀

3.76E+00

4.88E+00

6.06E+00

4.88E+00

Normal

1.00

5.00

5.37E+00

4.39E+00

0.31

0.31

Each

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

6.5E+01

Normal

0.38

9.3E+02

Normal

0.32

8.7E+02

Normal

0.31

Median Cost

Best Fit

CV or Beta

1.9E+03

Normal

0.38

1.8E+04

Normal

0.32

1.6E+04

Normal

0.31

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

1

02/26/19

Line 566

Fire Sprinkler Water Piping - Horizontal Mains and Branches - Old Style Victaulic - Thin Wall Steel - No bracing, SDC A or B, PIPING FRAGILITY
Costing based upon 1000 ft segments of pipe, horizontal main and branches

Illustrations

Replace leaking joints and minor water cleanup.	Replace 20 ft section of pipe, joints and major water cleanup at leaking joints.
---	--

One failure is expected per 1000 feet of pipe. Allowance included for MEP modifications for repair.
Not Given
By User
By User
Not Given
2011-08-24 Negative probability below 0.5 g - overlap deemed acceptable. 2016-10-25 Clarification of cost added

Root Cost Multiplier: 50
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D4011.022a

Fire Sprinkler Water Piping - Horizontal Mains and Branches - Old Style Victaulic - Thin Wall Steel - No bracing, SDC C, PIPING FRAGILITY

Costing based upon 1000 ft segments of pipe, horizontal main and branches

Line 567

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

SDC C (low seismic design)

LF 1000

Peak Floor Acceleration

2

DS1

Sequential

Seq(DS1,DS2)

Spraying & Dripping Leakage at joints - 0.02 leaks per 20 ft section of pipe.

Joints Break - Major Leakage - 0.02 breaks per 20 ft section of pipe.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

NO

NO

Yes

Illustrations

none

1.00

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.1

Not Specified

Not Specified

0.4

NO

NO

2.4

Not Specified

Not Specified

0.5

Data Quality Marginal

Data Relevance Marginal

Documentation Quality Marginal

Rationality Marginal

Consequence Functions

Repair Description

Replace leaking joints and minor water cleanup.

Replace 20 ft section of pipe, joints and major water cleanup at leaking joints.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.50E+02

3.50E+02

8.00E+02

3.48E+02

LogNormal

3.00

10.00

3.85E+02

3.15E+02

2.92E+03

2.39E+03

0.65

0.65

0.41

0.41

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

1.50E+03

2.65E+03

4.35E+03

2.60E+03

LogNormal

3.00

10.00

2.92E+03

2.39E+03

0.41

0.41

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.75E-01

4.10E-01

9.40E-01

4.10E-01

LogNormal

3.00

10.00

4.51E-01

3.69E-01

9.37E-01

3.13E-01

0.70

0.70

0.48

0.48

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

3.55E-01

6.25E-01

1.03E+00

6.25E-01

LogNormal

3.00

10.00

9.37E-01

3.13E-01

0.48

0.48

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

3.3E+01

LogNormal

0.70

3.6E+02

LogNormal

0.48

Median Cost

Best Fit

CV or Beta

3.6E+02

LogNormal

0.48

9.2E+03

LogNormal

0.48

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

One failure is expected per 1000 feet of pipe. Allowance included for MEP modifications for repair.

Not Given

By User

By User

Not Given

2011-08-24 Negative probability below 0.5 g - overlap deemed acceptable. 2016-10-25 Clarification of cost added.

Root Cost Multiplier:

Date Generated:

50

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D4011.023a

Fire Sprinkler Water Piping - Horizontal Mains and Branches - Old Style Victaulic - Thin Wall Steel - Poorly designed bracing, SDC D, E, or F , PIPING FRAGILITY

Costing based upon 1000 ft segments of pipe, horizontal main and branches

Line 568

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

SDC D,E,F (high seismic design)

LF 1000

Peak Floor Acceleration

g

2

DS1

DS2

Sequential

Seq(DS1,DS2)

Spraying & Dripping Leakage at joints - 0.02 leaks per 20 ft section of pipe.

Joints Break - Major Leakage - 0.02 breaks per 20 ft section of pipe.

Illustrations

none

none

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.00

1.00

1.5

Not Specified

Not Specified

0.4

NO

NO

2.6

Not Specified

Not Specified

0.4

Data Quality Marginal

Data Relevance Marginal

Documentation Quality Marginal

Rationality Marginal

Consequence Functions

Repair Description

Replace leaking joints and minor water cleanup.

Replace 20 ft section of pipe, joints and major water cleanup at leaking joints.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Time:

Environmental Impacts:

LifeSafety Hazard:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.50E+02

3.50E+02

8.00E+02

3.48E+02

LogNormal

3.00

10.00

3.85E+02

3.15E+02

2.92E+03

2.39E+03

0.65

0.65

0.41

0.41

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

1.50E+03

2.65E+03

4.35E+03

2.60E+03

LogNormal

3.00

10.00

2.92E+03

2.39E+03

0.41

0.41

Each (1000 ft pipe)

Repair Time:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.75E-01

4.10E-01

9.40E-01

4.10E-01

LogNormal

3.00

10.00

4.51E-01

3.69E-01

9.37E-01

3.13E-01

0.70

0.70

0.48

0.48

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

3.55E-01

6.25E-01

1.03E+00

6.25E-01

LogNormal

3.00

10.00

9.37E-01

3.13E-01

0.48

0.48

Each (1000 ft pipe)

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

3.3E+01

LogNormal

0.70

3.6E+02

LogNormal

0.48

8.6E+02

LogNormal

0.70

9.2E+03

LogNormal

0.48

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

NO

NO

0%

0.00

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

One failure is expected per 1000 feet of pipe. Allowance included for MEP modifications for repair.

Not Given

By User

By User

Not Given

2016-10-25 Clarification of cost added.

Root Cost Multiplier:

50

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D4011.024a

Fire Sprinkler Water Piping - Horizontal Mains and Branches - Old Style Victaulic - Thin Wall Steel - with designed bracing, SDC D, E, or F (OSHDP or sim), PIPING FRAGILIT

Line 569

Costing based upon 1000 ft segments of pipe, horizontal main and branches

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Special Regulation (e.g. OSHPD) for sprinkler installations

SDC D,E,F (high seismic design)

LF 1000

Peak Floor Acceleration

g

2

DS1

Sequential

Seq(DS1,DS2)

Spraying & Dripping Leakage at joints - 0.02 leaks per 20 ft section of pipe.

DS2

Sequential

Not Specified

Joints Break - Major Leakage - 0.02 breaks per 20 ft section of pipe.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

none

none

Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.9

Not Specified

Not Specified

0.4

3.4

Not Specified

Not Specified

0.4

NO

NO

Data Quality

Marginal

Documentation Quality

Marginal

Data Relevance

Marginal

Rationality

Marginal

Consequence Functions

Repair Description

Replace leaking joints and minor water cleanup.

Replace 20 ft section of pipe, joints and major water cleanup at leaking joints.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.50E+02

3.50E+02

8.00E+02

3.48E+02

LogNormal

3.00

10.00

3.85E+02

3.15E+02

2.92E+03

2.39E+03

0.65

0.65

0.41

0.41

Each (1000 ft pipe)

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀P₅₀P₉₀

1.75E-01

4.10E-01

9.40E-01

4.10E-01

LogNormal

3.00

10.00

4.51E-01

3.69E-01

9.37E-01

3.13E-01

0.70

0.70

0.48

0.48

Each (1000 ft pipe)

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

3.3E+01

LogNormal

0.70

3.6E+02

LogNormal

0.48

8.6E+02

LogNormal

0.70

9.2E+03

LogNormal

0.48

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

NO

NO

0%

0.00

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

One failure is expected per 1000 feet of pipe. Allowance included for MEP modifications for repair.

Not Given

By User

By User

Not Given

2016-10-25 Clarification of cost added.

Root Cost Multiplier:

50

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D4011.031a

Fire Sprinkler Drop Standard Threaded Steel - Dropping into unbraced lay-in tile SOFT ceiling - 6 ft. long drop maximum, SDC A or B

Costing per 100 units, Standard threaded steel drop, 6 ft. long drop maximum

Line 570

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

SDC A or B (no seismic design)

EA 100

g

2

DS1

Sequential

Seq(DS1,DS2)

Spraying & Dripping Leakage at drop joints - 0.01 leaks per drop.

DS2

Sequential

Drop Joints Break - Major Leakage - 0.01 breaks per drop.

Illustrations

none

1.00

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.75

Not Specified

Not Specified

0.4

NO

NO

0.95

Not Specified

Not Specified

0.4

Data Quality Marginal

Data Relevance Marginal

Documentation Quality Marginal

Rationality Marginal

Consequence Functions

Repair Description

Replace sprinkler drops and minor water cleanup at broken joints.

Replace sprinkler drops and major water cleanup at broken joints

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Time:

Environmental Impacts:

LifeSafety Hazard:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

3.50E+02

5.00E+02

8.50E+02

5.26E+02

LogNormal

2.00

5.00

5.50E+02

4.50E+02

0.37

0.37

100 Units

P₁₀

P₅₀

P₉₀

3.50E+02

5.00E+02

8.50E+02

5.26E+02

LogNormal

2.00

5.00

5.50E+02

4.50E+02

0.37

0.37

100 Units

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.20E-01

1.80E-01

3.00E-01

1.80E-01

LogNormal

2.00

5.00

2.39E-01

1.21E-01

0.44

0.44

100 Units

P₁₀

P₅₀

P₉₀

4.10E-01

5.90E-01

1.00E+00

5.90E-01

LogNormal

2.00

5.00

6.49E-01

5.31E-01

0.44

0.44

100 Units

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

7.5E+01

LogNormal

0.44

7.5E+01

LogNormal

0.44

8.7E+02

LogNormal

0.44

Median Cost

Best Fit

CV or Beta

7.5E+01

LogNormal

0.44

7.5E+01

LogNormal

0.44

8.7E+02

LogNormal

0.44

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

One failure is expected per 100 units. Allowance included for MEP modifications for repair.

Not Given

By User

By User

Not Given

2016-10-25 Clarification of cost added.

Root Cost Multiplier:

Date Generated:

100

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

D4011.032a

NISTIR Name

Fire Sprinkler Drop Standard Threaded Steel - Dropping into unbraced lay-in tile SOFT ceiling - 6 ft. long drop maximum, SDC C

Description

Costing per 100 units, Standard threaded steel drop, 6 ft. long drop maximum

Line 571

Construction Quality:

Normal

Seismic Installation Conditions:

SDC C (low seismic design)

Fragility Unit of Measure:

EA 100

Demand Parameter (unit):

Peak Floor Acceleration g

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	Yes	

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Spraying & Dripping Leakage at drop joints - 0.01 leaks per drop. Drop Joints Break - Major Leakage - 0.01 breaks per drop.

Illustrations

none	none			
1.00	1.00			

Damage State Probability:

Fragility Parameters

Median Demand, θ :

0.75

0.95

Data dispersion, β_d :

Not Specified

Not Specified

Uncertainty, β_u :

Not Specified

Not Specified

Total Dispersion, β :

0.4

0.4

Correlation (Yes / No)

NO

Data Quality Marginal

Documentation Quality Marginal

Directionality (Yes / No)

NO

Data Relevance Marginal

Rationality Marginal

Consequence Functions

Repair Description

Replace sprinkler drops and minor water cleanup at broken joints. Replace sprinkler drops and major water cleanup at broken joints

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Cost by Damage State:	3.50E+02	5.00E+02	8.50E+02	3.50E+02	5.00E+02	8.50E+02									
Best fit mean:	5.26E+02			5.26E+02											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	2.00			2.00											
Average Repair Cost (Min Qty, Max Qty)	5.50E+02			5.50E+02											
CV or beta (Min Qty, Max Qty)	0.37			0.37											
Quantity Unit:	100 Units			100 Units											
Repair Time:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Time by Damage State:	1.20E-01	1.80E-01	3.00E-01	4.10E-01	5.90E-01	1.00E+00									
Best fit mean:	1.80E-01			5.90E-01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	2.00			2.00											
Average Repair Time (Min Qty, Max Qty)	2.39E-01			6.49E-01											
CV or beta (Min Qty, Max Qty)	0.44			0.44											
Quantity Unit:	100 Units			100 Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	7.5E+01	LogNormal	0.44	7.5E+01	LogNormal	0.44									
Embodied Energy (MJ)	8.7E+02	LogNormal	0.44	8.7E+02	LogNormal	0.44									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										

Comments:

One failure is expected per 100 units. Allowance included for MEP modifications for repair.

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2016-10-25 Clarification of cost added.

Root Cost Multiplier: 100

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D4011.033a

Fire Sprinkler Drop Standard Threaded Steel - Dropping into unbraced lay-in tile SOFT ceiling - 6 ft. long drop maximum, SDC D, E, or F

Costing per 100 units, Standard threaded steel drop, 6 ft. long drop maximum

Line 572

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

SDC D,E,F (high seismic design)

EA 100

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

Spraying & Dripping Leakage at drop joints - 0.01 leaks per drop.

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.95

Not Specified

Not Specified

0.4

NO

NO

Data Quality

Data Relevance

Marginal

Marginal

Documentation Quality

Rationality

Marginal

Marginal

Consequence Functions

Repair Description

Replace sprinkler drops and minor water cleanup at broken joints.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Time:

Environmental Impacts:

LifeSafety Hazard:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

5.26E+02

LogNormal

2.00

5.00

5.50E+02

4.50E+02

0.37

0.37

100 Units

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

5.90E-01

LogNormal

2.00

5.00

6.49E-01

5.31E-01

0.44

0.44

100 Units

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

7.5E+01

LogNormal

0.44

8.7E+02

LogNormal

0.44

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

One failure is expected per 100 units. Allowance included for MEP modifications for repair.

Not Given

By User

By User

Not Given

2016-10-25 Clarification of cost added.

Root Cost Multiplier:

Date Generated:

100

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D4011.034a

Fire Sprinkler Drop Standard Threaded Steel - Dropping into unbraced lay-in tile SOFT ceiling - 6 ft. long drop maximum, SDC D, E, or F (OSHPD or sim)

Costing per 100 units, Standard threaded steel drop, 6 ft. long drop maximum

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Special Regulation (e.g. OSHPD) for sprinkler installations

SDC D,E,F (high seismic design)

EA 100

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

Spraying & Dripping Leakage at drop joints - 0.01 leaks per drop.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

NO

NO

Data Quality

Marginal

Data Relevance

Marginal

Documentation Quality

Marginal

Rationality

Marginal

Consequence Functions

Repair Description

Replace sprinkler drops and minor water cleanup at broken joints.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

100 Units

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

100 Units

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

One failure is expected per 100 units. Allowance included for MEP modifications for repair.

Not Given

By User

By User

Not Given

2016-10-25 Clarification of cost added.

Root Cost Multiplier:

100

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D4011.041a

Fire Sprinkler Drop Standard Threaded Steel - Dropping into unbraced lay-in tile HARD ceiling - 6 ft. long drop maximum, SDC A or B

Costing per 100 units, Standard threaded steel drop, 6 ft. long drop maximum

Line574

Construction Quality:Normal

Seismic Installation Conditions:SDC A or B (no seismic design)

Fragility Unit of Measure:EA 100

Demand Parameter (unit):Peak Floor Accelerationg

Number of Damage States:2

Damage State:DS1

Type of Damage State:Sequential

DS HierarchySeq(DS1,DS2)

Descriptions

DS1:Spraying & Dripping Leakage at drop joints - 0.01 leaks per drop.

DS2:Drop Joints Break - Major Leakage - 0.01 breaks per drop.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

none

none

Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

NO

NO

Data Quality

Marginal

Documentation Quality

Marginal

Rationality

Marginal

Consequence Functions

Repair Description

Replace sprinkler drops and minor water cleanup at broken joints.

Replace sprinkler drops and major water cleanup at broken joints

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

100 Units

100 Units

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

100 Units

100 Units

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

One failure is expected per 100 units. Allowance included for MEP modifications for repair.

Not Given

By User

By User

Not Given

2016-10-25 Clarification of cost added.

Root Cost Multiplier:

100

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D4011.042a

Fire Sprinkler Drop Standard Threaded Steel - Dropping into unbraced lay-in tile HARD ceiling - 6 ft. long drop maximum, SDC C

Costing per 100 units, Standard threaded steel drop, 6 ft. long drop maximum

Line575

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

SDC C (low seismic design)

EA 100

g

2

DS1

DS2

Sequential

Sequential

Seq(DS1,DS2)

Spraying & Dripping Leakage at drop joints - 0.01 leaks per drop.

Drop Joints Break - Major Leakage - 0.01 breaks per drop.

Illustrations

none

1.00

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.55

Not Specified

Not Specified

0.4

0.95

Not Specified

Not Specified

0.4

Data Quality

Data Relevance

Marginal

Marginal

Documentation Quality

Rationality

Marginal

Marginal

Consequence Functions

Repair Description

Replace sprinkler drops and minor water cleanup at broken joints.

Replace sprinkler drops and major water cleanup at broken joints

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Time:

Environmental Impacts:

LifeSafety Hazard:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

3.50E+02

5.00E+02

8.50E+02

5.26E+02

LogNormal

2.00

5.00

5.50E+02

4.50E+02

0.37

0.37

100 Units

P₁₀

P₅₀

P₉₀

3.50E+02

5.00E+02

8.50E+02

5.26E+02

LogNormal

2.00

5.00

5.50E+02

4.50E+02

0.37

0.37

100 Units

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

4.10E-01

5.90E-01

1.00E+00

5.90E-01

LogNormal

2.00

5.00

6.49E-01

5.31E-01

0.44

0.44

100 Units

P₁₀

P₅₀

P₉₀

8.00E-02

1.20E-01

2.00E-01

1.20E-01

LogNormal

2.00

5.00

1.79E-01

6.12E-02

0.44

0.44

100 Units

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

7.5E+01

LogNormal

0.44

8.7E+02

LogNormal

0.44

7.5E+01

LogNormal

0.44

8.7E+02

LogNormal

0.44

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

One failure is expected per 100 units. Allowance included for MEP modifications for repair.

Not Given

By User

By User

Not Given

2016-10-25 Clarification of cost added.

Root Cost Multiplier:

Date Generated:

100

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D4011.053a

Fire Sprinkler Drop Standard Threaded Steel - Dropping into braced lay-in tile SOFT ceiling - 6 ft. long drop maximum, SDC D, E, or F

Costing per 100 units, Standard threaded steel drop, 6 ft. long drop maximum

Line 576

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

SDC D,E,F (high seismic design)

EA 100

Peak Floor Acceleration

g

2

DS1

DS2

Sequential

Seq(DS1,DS2)

Spraying & Dripping Leakage at drop joints - 0.01 leaks per drop.

Drop Joints Break - Major Leakage - 0.01 breaks per drop.

Illustrations

none

1.00

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.5

Not Specified

Not Specified

0.4

2.25

Not Specified

Not Specified

0.4

NO

NO

Data Quality

Marginal

Documentation Quality

Marginal

Data Relevance

Marginal

Rationality

Marginal

Consequence Functions

Repair Description

Replace sprinkler drops and minor water cleanup at broken joints.

Replace sprinkler drops and major water cleanup at broken joints

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Time:

Environmental Impacts:

LifeSafety Hazard:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

3.50E+02

5.00E+02

8.50E+02

5.26E+02

LogNormal

2.00

5.00

5.50E+02

4.50E+02

0.37

0.37

100 Units

P₁₀

P₅₀

P₉₀

3.50E+02

5.00E+02

8.50E+02

5.26E+02

LogNormal

2.00

5.00

5.50E+02

4.50E+02

0.37

0.37

100 Units

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

4.10E-01

5.90E-01

1.00E+00

5.90E-01

LogNormal

2.00

5.00

6.49E-01

5.31E-01

0.44

0.44

100 Units

P₁₀

P₅₀

P₉₀

8.00E-02

1.20E-01

2.00E-01

1.20E-01

LogNormal

2.00

5.00

1.79E-01

6.12E-02

0.44

0.44

100 Units

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

7.5E+01

LogNormal

0.44

7.5E+01

LogNormal

0.44

8.7E+02

LogNormal

0.44

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

One failure is expected per 100 units. Allowance included for MEP modifications for repair.

Not Given

By User

By User

Not Given

2016-10-25 Clarification of cost added.

Root Cost Multiplier:

Date Generated:

100

02/26/19

Line 577

Fire Sprinkler Drop Standard Threaded Steel - Dropping into braced lay-in tile SOFT ceiling - 6 ft. long drop maximum, SDC D, E, or F (OSHPD or sim)
Costing per 100 units, Standard threaded steel drop, 6 ft. long drop maximum

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Fragility Unit of Measure:	EA 100	
Demand Parameter (unit):	Peak Floor Acceleration g	
Number of Damage States:	2	
Damage State:	DS1	DS2
Type of Damage State:	Sequential	Sequential
DS Hierarchy	Seq(DS1,DS2)	
Descriptions	Spraying & Dripping Leakage at drop joints - 0.01 leaks per drop.	Drop Joints Break - Major Leakage - 0.01 breaks per Drop.

Illustrations

none	none			

Damage State Probability:

Demand State Probability:	1.00	1.00
Fragility Parameters		
Median Demand, θ :	1.9	3
Data dispersion, β_d :	Not Specified	Not Specified
Uncertainty, β_u :	Not Specified	Not Specified
Total Dispersion β :	0.4	0.4

Total Dispersion, σ^2:	0.4	0.4		
Correlation (Yes / No)	NO	Data Quality Marginal		Documentation Quality Marginal
Directionality (Yes / No)	NO	Data Relevance Marginal		Rationality Marginal

Consequence Functions

Consequence Functions	Repair Description	Repair Description
	Replace sprinkler drops and minor water cleanup at broken joints.	Replace sprinkler drops and major water cleanup at broken joints.

Long Lead Time (Yes / No)

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.50E+02	5.00E+02	8.50E+02	3.50E+02	5.00E+02	8.50E+02									
Best fit mean:	5.26E+02 LogNormal			5.26E+02 LogNormal											
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	2.00		5.00	2.00		5.00									
Average Repair Cost (Min Qty, Max Qty)	5.50E+02		4.50E+02	5.50E+02		4.50E+02									
CV or beta (Min Qty, Max Qty)	0.37		0.37	0.37		0.37									
Quantity Unit:	100 Units			100 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	4.10E-01	5.90E-01	1.00E+00	8.00E-02	1.20E-01	2.00E-01									
Best fit mean:	5.90E-01 LogNormal			1.20E-01 LogNormal											
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	2.00		5.00	2.00		5.00									
Average Repair Time (Min Qty, Max Qty)	6.49E-01		5.31E-01	1.79E-01		6.12E-02									
CV or beta (Min Qty, Max Qty)	0.44		0.44	0.44		0.44									
Quantity Unit:	100 Units			100 Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	7.5E+01	LogNormal	0.44	7.5E+01	LogNormal	0.44									
Embodied Energy (MJ)	8.7E+02	LogNormal	0.44	8.7E+02	LogNormal	0.44									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:															
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										

Comments: One failure is expected per 100 units. Allowance included for MEP modifications for repair.

Date Created:
Approved (YES / NO)?
Official (YES / NO) ?
Author:
Revisions:

Root Cost Multiplier: 100
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D4011.063a

Fire Sprinkler Drop Standard Threaded Steel - Dropping into braced lay-in tile HARD ceiling - 6 ft. long drop maximum, SDC D, E, or F

Costing per 100 units, Standard threaded steel drop, 6 ft. long drop maximum

Line 578

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

SDC D,E,F (high seismic design)

EA 100

Peak Floor Acceleration

2

DS1

Sequential

Seq(DS1,DS2)

Spraying & Dripping Leakage at drop joints - 0.01 leaks per drop.

Drop Joints Break - Major Leakage - 0.01 breaks per drop.

Illustrations

none

1.00

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.55

Not Specified

Not Specified

0.4

NO

NO

1.3

Not Specified

Not Specified

0.4

Data Quality Marginal

Data Relevance Marginal

Documentation Quality Marginal

Rationality Marginal

Consequence Functions

Repair Description

Replace sprinkler drops and minor water cleanup at broken joints.

Replace sprinkler drops and major water cleanup at broken joints

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Time:

Environmental Impacts:

LifeSafety Hazard:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

3.50E+02

5.00E+02

8.50E+02

5.26E+02

LogNormal

2.00

5.00

5.50E+02

4.50E+02

0.37

0.37

100 Units

P₁₀

P₅₀

P₉₀

3.50E+02

5.00E+02

8.50E+02

5.26E+02

LogNormal

2.00

5.00

5.50E+02

4.50E+02

0.37

0.37

100 Units

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.20E-01

1.80E-01

3.00E-01

1.80E-01

LogNormal

2.00

5.00

2.39E-01

1.21E-01

0.44

0.44

100 Units

P₁₀

P₅₀

P₉₀

4.10E-01

5.90E-01

1.00E+00

5.90E-01

LogNormal

2.00

5.00

6.49E-01

5.31E-01

0.44

0.44

100 Units

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Median Cost

Best Fit

CV or Beta

7.5E+01

LogNormal

0.44

Median Cost

Best Fit

CV or Beta

7.5E+01

LogNormal

0.44

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

7.5E+01

LogNormal

0.44

7.5E+01

LogNormal

0.44

7.7E+02

LogNormal

0.44

8.7E+02

LogNormal

0.44

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

One failure is expected per 100 units. Allowance included for MEP modifications for repair.

Not Given

By User

By User

Not Given

2016-10-25 Clarification of cost added.

Root Cost Multiplier:

Date Generated:

100

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D4011.064a

Fire Sprinkler Drop Standard Threaded Steel - Dropping into braced lay-in tile HARD ceiling - 6 ft. long drop maximum, SDC D, E, or F (OSHPD or sim)

Costing per 100 units, Standard threaded steel drop, 6 ft. long drop maximum

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Special Regulation (e.g. OSHPD) for sprinkler installations

SDC D,E,F (high seismic design)

EA 100

Peak Floor Acceleration

g

2

DS1

Sequential

Seq(DS1,DS2)

Spraying & Dripping Leakage at drop joints - 0.01 leaks per drop.

DS2

Sequential

Drop Joints Break - Major Leakage - 0.01 breaks per drop.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

none

none

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Data Quality

Data Relevance

Marginal

Documentation Quality

Rationality

Marginal

Consequence Functions

Repair Description

Replace sprinkler drops and minor water cleanup at broken joints.

Replace sprinkler drops and major water cleanup at broken joints

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

7.5E+01

LogNormal

0.44

7.5E+01

LogNormal

0.44

7.7E+02

LogNormal

0.44

7.7E+02

LogNormal

0.44

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

One failure is expected per 100 units. Allowance included for MEP modifications for repair.

Not Given

By User

By User

Not Given

2016-10-25 Clarification of cost added.

Root Cost Multiplier:

Date Generated:

100

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

D4011.072a

NISTIR Name
Description

Fire Sprinkler Drop Standard Threaded Steel - No Ceiling - 6 ft. long drop maximum, SDC C
Costing per 100 units, Standard threaded steel drop, 6 ft. long drop maximum

Line 581

Construction Quality:	Normal				<div>Quantity RoundingRound Qty?NO</div> <div>Allow sum by floor or building?NO</div> <div>Demand Location (floor above?)Yes</div>
Seismic Installation Conditions:	SDC C (low seismic design)				
Fragility Unit of Measure:	EA 100				
Demand Parameter (unit):	Peak Floor Accelerationg				
Number of Damage States:	2				
Damage State:	DS1		DS2		
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Spraying & Dripping Leakage at drop joints - 0.01 leaks per drop.		Drop Joints Break - Major Leakage - 0.01 breaks per drop.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations

none	none			
1.00	1.00			

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	1.5	2.25		
Data dispersion, β_d :	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified		
Total Dispersion, β :	0.4	0.4		
Correlation (Yes / No)	NO	Data Quality Marginal	Documentation Quality Marginal	
Directionality (Yes / No)	NO	Data Relevance Marginal	Rationality Marginal	

Consequence Functions
Repair Description

Replace sprinkler drops and minor water cleanup at broken joints.
Replace sprinkler drops and major water cleanup at broken joints

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.50E+02	5.00E+02	8.50E+02	3.50E+02	5.00E+02	8.50E+02									
Best fit mean:	5.26E+02			5.26E+02											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	2.00 5.00			2.00 5.00											
Average Repair Cost (Min Qty, Max Qty)	5.50E+02 4.50E+02			5.50E+02 4.50E+02											
CV or beta (Min Qty, Max Qty)	0.37 0.37			0.37 0.37											
Quantity Unit:	100 Units			100 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.20E-01	1.80E-01	3.00E-01	4.10E-01	5.90E-01	1.00E+00									
Best fit mean:	1.80E-01			5.90E-01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	2.00 5.00			2.00 5.00											
Average Repair Time (Min Qty, Max Qty)	2.39E-01 1.21E-01			6.49E-01 5.31E-01											
CV or beta (Min Qty, Max Qty)	0.44 0.44			0.44 0.44											
Quantity Unit:	100 Units			100 Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	7.5E+01	LogNormal	0.44	7.5E+01	LogNormal	0.44									
Embodied Energy (MJ)	8.7E+02	LogNormal	0.44	8.7E+02	LogNormal	0.44									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										

Comments: One failure is expected per 100 units. Allowance included for MEP modifications for repair.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2016-10-25 Clarification of cost added.

Root Cost Multiplier: 100
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D4011.073a

Fire Sprinkler Drop Standard Threaded Steel - No Ceiling - 6 ft. long drop maximum, SDC D, E, or F

Costing per 100 units, Standard threaded steel drop, 6 ft. long drop maximum

Line 582

Construction Quality:	Normal				<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? Yes</div>
Seismic Installation Conditions:	SDC D,E,F (high seismic design)				
Fragility Unit of Measure:	EA 100				
Demand Parameter (unit):	Peak Floor Accelerationg				
Number of Damage States:	2				
Damage State:	DS1		DS2		
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Spraying & Dripping Leakage at drop joints - 0.01 leaks per drop.		Drop Joints Break - Major Leakage - 0.01 breaks per drop.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations

none	none			
1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	2.6	3			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO	Data Quality Marginal		Documentation Quality Marginal	
Directionality (Yes / No)	NO	Data Relevance Marginal		Rationality Marginal	

Consequence Functions		
Repair Description	Replace sprinkler drops and minor water cleanup at broken joints.	Replace sprinkler drops and major water cleanup at broken joints

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.50E+02	5.00E+02	8.50E+02	3.50E+02	5.00E+02	8.50E+02									
Best fit mean:	5.26E+02			5.26E+02											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	2.00 5.00			2.00 5.00											
Average Repair Cost (Min Qty, Max Qty)	5.50E+02 4.50E+02			5.50E+02 4.50E+02											
CV or beta (Min Qty, Max Qty)	0.37 0.37			0.37 0.37											
Quantity Unit:	100 Units			100 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	4.10E-01	5.90E-01	1.00E+00	8.00E-02	1.20E-01	2.00E-01									
Best fit mean:	5.90E-01			1.20E-01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	2.00 5.00			2.00 5.00											
Average Repair Time (Min Qty, Max Qty)	6.49E-01 5.31E-01			1.79E-01 6.12E-02											
CV or beta (Min Qty, Max Qty)	0.44 0.44			0.44 0.44											
Quantity Unit:	100 Units			100 Units											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	7.5E+01	LogNormal	0.44	7.5E+01	LogNormal	0.44									
Embodied Energy (MJ)	8.7E+02	LogNormal	0.44	8.7E+02	LogNormal	0.44									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

One failure is expected per 100 units. Allowance included for MEP modifications for repair.

Not Given

By User

By User

Not Given

2016-10-25 Clarification of cost added.

Root Cost Multiplier:

Date Generated:

100

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D4011.074a

Fire Sprinkler Drop Standard Threaded Steel - No Ceiling - 6 ft. long drop maximum, SDC D, E, or F (OSHPD or sim)

Costing per 100 units, Standard threaded steel drop, 6 ft. long drop maximum

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Special Regulation (e.g. OSHPD) for sprinkler installations

SDC D,E,F (high seismic design)

EA 100

Peak Floor Acceleration

g

2

DS1

Sequential

Seq(DS1,DS2)

Spraying & Dripping Leakage at drop joints - 0.01 leaks per drop.

DS2

Sequential

Drop Joints Break - Major Leakage - 0.01 breaks per drop.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

none

none

Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

3.75

Not Specified

Not Specified

0.4

4.5

Not Specified

Not Specified

0.4

Correlation (Yes / No)

NO

Data Quality

Marginal

Documentation Quality

Marginal

Directionality (Yes / No)

NO

Data Relevance

Marginal

Rationality

Marginal

Consequence Functions

Repair Description

Replace sprinkler drops and minor water cleanup at broken joints.

Replace sprinkler drops and major water cleanup at broken joints

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

3.50E+02

5.00E+02

8.50E+02

5.26E+02

LogNormal

2.00

5.00

5.50E+02

4.50E+02

0.37

0.37

100 Units

P₁₀

P₅₀

P₉₀

3.50E+02

5.00E+02

8.50E+02

5.26E+02

LogNormal

2.00

5.00

5.50E+02

4.50E+02

0.37

0.37

100 Units

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

4.10E-01

5.90E-01

1.00E+00

5.90E-01

LogNormal

2.00

5.00

6.49E-01

5.31E-01

0.44

0.44

100 Units

P₁₀

P₅₀

P₉₀

8.00E-02

1.20E-01

2.00E-01

1.20E-01

LogNormal

2.00

5.00

1.79E-01

6.12E-02

0.44

0.44

100 Units

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

7.5E+01

LogNormal

0.44

Median Cost

Best Fit

CV or Beta

7.5E+01

LogNormal

0.44

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

One failure is expected per 100 units. Allowance included for MEP modifications for repair.

Not Given

By User

By User

Not Given

2016-10-25 Clarification of cost added.

Root Cost Multiplier:

100

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5011.011b

Transformer/primary service - Capacity: 100 to <350 kVA - Unanchored equipment that is not vibration isolated - Equipment fragility only

Costing is per unit and is based upon 250 kVA.

Line 585

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Unanchored equipment that is not vibration isolated

KV 250

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.00

1.01

0.6

0.1

0.6

NO

NO

Data Quality

Superior

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Service and repair existing transformer.
Transformer tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.05E+04

2.43E+04

3.23E+04

2.52E+04

LogNormal

1.00

5.00

2.67E+04

2.18E+04

0.18

0.18

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

3.62E+00

4.28E+00

5.70E+00

4.28E+00

LogNormal

1.00

5.00

7.13E+00

2.14E+00

0.31

0.31

Each

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

5.6E+03

LogNormal

0.31

1.0E+05

LogNormal

0.31

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2016-10-25 Clarification of cost added.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5011.011c

Transformer/primary service - Capacity: 350 to <750 kVA - Unanchored equipment that is not vibration isolated - Equipment fragility only

Costing is per unit and is based upon 500 kVA.

Line 586

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Unanchored equipment that is not vibration isolated

KV 500

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.01

0.6

0.1

0.6

NO

NO

Data Quality

Data Relevance

Superior

Average

Documentation Quality

Rationality

Superior

Superior

Consequence Functions

Repair Description

Service and repair existing transformer.
Transformer tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

3.62E+04

4.27E+04

5.66E+04

4.44E+04

LogNormal

1.00

5.00

4.70E+04

3.84E+04

0.18

0.18

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

4.26E+00

5.02E+00

6.66E+00

5.02E+00

LogNormal

1.00

5.00

1.00E+01

2.51E+00

0.31

0.31

Each

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

1.0E+04

LogNormal

0.31

1.8E+05

LogNormal

0.31

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2016-10-25 Clarification of cost added.

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5011.011d

Transformer/primary service - Capacity: 750 to 1500 kVA - Unanchored equipment that is not vibration isolated - Equipment fragility only

Costing is per unit and is based upon 1000 kVa.

Line 587

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Unanchored equipment that is not vibration isolated

KV 1000

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.01

0.6

0.1

0.6

NO

NO

Data Quality

Data Relevance

Superior

Average

Documentation Quality

Rationality

Superior

Superior

Consequence Functions

Repair Description

Service and repair existing transformer.
Transformer tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

4.75E+04

5.70E+04

7.48E+04

5.87E+04

LogNormal

1.00

5.00

6.27E+04

5.13E+04

0.18

0.18

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

3.91E+00

4.69E+00

6.16E+00

4.69E+00

LogNormal

1.00

5.00

1.14E+01

2.35E+00

0.31

0.31

Each

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

1.3E+04

LogNormal

0.31

2.4E+05

LogNormal

0.31

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2016-10-25 Clarification of cost added.

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5011.013a

Transformer/primary service - Capacity: <100 kVA - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragility

Line 588

Costing is per unit and is based upon 75 kVA.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

2

DS1

DS2

Mutually Exclusive

Mutually Exclusive

MutEx(DS1.DS2)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Illustrations



Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

NO

NO

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

Data Quality Superior

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Transformer tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No) NO YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	5.00E+02	1.00E+03	1.70E+03	6.60E+03	8.58E+03	1.15E+04									
Best fit mean:	9.59E+02			8.66E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00			5.00											
Average Repair Cost (Min Qty, Max Qty)	1.10E+03			9.00E+02			9.43E+03			7.72E+03					
CV or beta (Min Qty, Max Qty)	0.45			0.45			0.22			0.22					
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.88E-01	1.18E+00	2.00E+00	7.76E+00	1.01E+01	1.35E+01									
Best fit mean:	1.18E+00			1.01E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00			5.00			1.00			5.00					
Average Repair Time (Min Qty, Max Qty)	1.29E+00			1.06E+00			1.11E+01			9.08E+00					
CV or beta (Min Qty, Max Qty)	0.52			0.52			0.33			0.33					
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	1.1E+02	LogNormal	0.52	1.8E+03	LogNormal	0.33									
Embodied Energy (MJ)	3.2E+03	LogNormal	0.52	3.3E+04	LogNormal	0.33									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%			0%			0%			0%					
Loss of Life (Median, Dispersion)	0%			0%			0%			0%					
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%			0%											

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

2016-10-25 Clarification of cost added.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5011.013b

Transformer/primary service - Capacity: <100 kVA - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

Costing is per unit and is based upon 75 kVa.

Line 589

Transformer/primary service - Capacity: <100 kVA - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragility

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

KV 75

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

3.05

0.6

0.1

0.5

NO

NO

Data Quality

Superior

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Service and repair existing transformer.
Transformer tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

6.10E+03

7.58E+03

9.80E+03

7.68E+03

LogNormal

1.00

5.00

8.33E+03

6.82E+03

0.19

0.19

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

5.83E+00

7.24E+00

9.37E+00

7.24E+00

LogNormal

1.00

5.00

7.96E+00

6.52E+00

0.31

0.31

Each

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

1.7E+03

LogNormal

0.31

3.0E+04

LogNormal

0.31

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2016-10-25 Clarification of cost added.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5011.013c

Transformer/primary service - Capacity: <100 kVA - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage

Costing is per unit and is based upon 75 kVA.

Line 590

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

KV 75

Peak Floor Acceleration

g

3

DS1

Mutually Exclusive

MutEx(DS1,DS2,DS3)

Anchorage failure.

DS2

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

DS3

Mutually Exclusive

Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

0.35



D5011.011a-DS1-1.JPG

0.15

none

0.50

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β_t :

Correlation (Yes / No)

Directionality (Yes / No)

NO

NO

Data Quality

Superior

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Transformer tower removed, repaired offsite, and reinstalled.

Service and repair existing transformer. Transformer tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

NO

YES

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	5.00E+02	1.00E+03	1.70E+03	6.60E+03	8.58E+03	1.15E+04	6.10E+03	7.58E+03	9.80E+03						
Best fit mean:	9.59E+02			8.66E+03			7.68E+03								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00						
Average Repair Cost (Min Qty, Max Qty)	1.10E+03		9.00E+02	9.43E+03		7.72E+03	8.33E+03		6.82E+03						
CV or beta (Min Qty, Max Qty)	0.45		0.45	0.22		0.22	0.19		0.19						
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	4.78E-01	9.56E-01	1.63E+00	1.26E+00	1.64E+00	2.20E+00	1.17E+00	1.45E+00	1.87E+00						
Best fit mean:	9.56E-01			1.64E+00			1.45E+00								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00						
Average Repair Time (Min Qty, Max Qty)	1.05E+00		8.60E-01	2.46E+00		8.20E-01	2.17E+00		7.24E-01						
CV or beta (Min Qty, Max Qty)	0.52		0.52	0.33		0.33	0.31		0.31						
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.1E+02	LogNormal	0.52	1.8E+03	LogNormal	0.33	1.7E+03	LogNormal	0.31						
Embodied Energy (MJ)	3.2E+03	LogNormal	0.52	3.3E+04	LogNormal	0.33	3.0E+04	LogNormal	0.31						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			NO								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

2016-10-25 Clarification of cost added.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5011.013d

Transformer/primary service - Capacity: 100 to <350 kVA - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fr
Costing is per unit and is based upon 250 kVA.

Line 591

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

KV 250

Peak Floor Acceleration

2

DS1

Mutually Exclusive

MutEx(DS1.DS2)

Anchorage failure.

DS2

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations



Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	By User	By User			
Data dispersion, β_d :	User to Calculate	User to Calculate			
Uncertainty, β_u :	User to Calculate	User to Calculate			
Total Dispersion, β :	By User	By User			
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Superior	
Directionality (Yes / No)	NO	Data Relevance Average		Rationality Superior	

Consequence Functions					
Repair Description	Repair anchorage and concrete pad and remount equipment.	Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Transformer tower removed, repaired offsite, and reinstalled.			

Long Lead Time (Yes / No) NO YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	8.00E+02	1.50E+03	2.40E+03	2.13E+04	2.58E+04	3.47E+04									
Best fit mean:	1.57E+03 Normal			2.67E+04 LogNormal											
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	1.00			1.00											
Average Repair Cost (Min Qty, Max Qty)	1.65E+03			2.83E+04											
CV or beta (Min Qty, Max Qty)	0.40			0.20											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	7.65E-01	1.43E+00	2.29E+00	3.05E+00	3.69E+00	4.98E+00									
Best fit mean:	1.43E+00 Normal			3.69E+00 LogNormal											
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	1.00			1.00											
Average Repair Time (Min Qty, Max Qty)	1.58E+00			6.15E+00											
CV or beta (Min Qty, Max Qty)	0.47			0.32											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.7E+02	Normal	0.47	5.8E+03	LogNormal	0.32									
Embodied Energy (MJ)	5.0E+03	Normal	0.47	1.1E+05	LogNormal	0.32									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%			0%											
Loss of Life (Median, Dispersion)	0%			0%											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%			0%											

Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.	
Date Created:	Not Given	Root Cost Multiplier: 1
Approved (YES / NO)?	By User	Date Generated: 02/26/19
Official (YES / NO) ?	By User	
Author:	Not Given	
Revisions:	2016-10-25 Clarification of cost added.	

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5011.013e

Transformer/primary service - Capacity: 100 to <350 kVA - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment f

Line 592

Costing is per unit and is based upon 250 kVA.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

KV 250

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

3.05

0.6

0.1

0.5

NO

NO

Data Quality

Data Relevance

Superior

Average

Documentation Quality

Rationality

Superior

Superior

Consequence Functions

Repair Description

Service and repair existing transformer.

Transformer tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.05E+04

2.43E+04

3.23E+04

2.52E+04

LogNormal

1.00

5.00

2.67E+04

2.18E+04

0.18

0.18

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.94E+00

3.48E+00

4.63E+00

3.48E+00

LogNormal

1.00

5.00

5.80E+00

1.74E+00

0.31

0.31

Each

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

5.6E+03

LogNormal

0.31

1.0E+05

LogNormal

0.31

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2016-10-25 Clarification of cost added.

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5011.013f

Transformer/primary service - Capacity: 100 to <350 kVA - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined ar

Line 593

Costing is per unit and is based upon 250 kVA.

Construction Quality:	Normal - Designed for seismic loads but no special seismic certification			
Seismic Installation Conditions:	Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints			
Fragility Unit of Measure:	KV 250			
Demand Parameter (unit):	Peak Floor Acceleration g			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive	
DS Hierarchy	MutEx(DS1,DS2,DS3)			
Descriptions	Anchorage failure.	Anchorage failure & Equipment damaged beyond repair.	Damaged, inoperative but anchorage is OK.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?	BLDG	
Demand Location (floor above?)	No	

Illustrations					
	none	D5011.011a-DS1-1.JPG	none		
Damage State Probability:	0.35	0.15	0.50		

Fragility Parameters					
Median Demand, θ :	By User	By User	By User		
Data dispersion, β_d :	User to Calculate	User to Calculate	User to Calculate		
Uncertainty, β_u :	User to Calculate	User to Calculate	User to Calculate		
Total Dispersion, β :	By User	By User	By User		
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Superior	
Directionality (Yes / No)	NO	Data Relevance Average		Rationality Superior	

Consequence Functions					
Repair Description	Repair anchorage and concrete pad and remount equipment.	Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Transformer tower removed, repaired offsite, and reinstalled.	Service and repair existing transformer. Transformer tower removed, repaired offsite, and reinstalled.		

Long Lead Time (Yes / No)	NO			YES			NO								
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	8.00E+02	1.50E+03	2.40E+03	2.13E+04	2.58E+04	3.47E+04	2.05E+04	2.43E+04	3.23E+04						
Best fit mean:	1.57E+03 Normal			2.67E+04 LogNormal			2.52E+04 LogNormal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	1.00	5.00		1.00	5.00		1.00	5.00							
Average Repair Cost (Min Qty, Max Qty)	1.65E+03	1.35E+03		2.83E+04	2.32E+04		2.67E+04	2.18E+04							
CV or beta (Min Qty, Max Qty)	0.40	0.40		0.20	0.20		0.18	0.18							
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	7.65E-01	1.43E+00	2.29E+00	3.05E+00	3.69E+00	4.98E+00	2.94E+00	3.48E+00	4.63E+00						
Best fit mean:	1.43E+00 Normal			3.69E+00 LogNormal			3.48E+00 LogNormal								
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	1.00	5.00		1.00	5.00		1.00	5.00							
Average Repair Time (Min Qty, Max Qty)	1.58E+00	1.29E+00		6.15E+00	1.85E+00		5.80E+00	1.74E+00							
CV or beta (Min Qty, Max Qty)	0.47	0.47		0.32	0.32		0.31	0.31							
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.7E+02	Normal	0.47	5.8E+03	LogNormal	0.32	5.6E+03	LogNormal	0.31						
Embodied Energy (MJ)	5.0E+03	Normal	0.47	1.1E+05	LogNormal	0.32	1.0E+05	LogNormal	0.31						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			NO								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

2016-10-25 Clarification of cost added.

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5011.013g

Transformer/primary service - Capacity: 350 to <750 kVA - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fr

Costing is per unit and is based upon 500 kVA.

Line 594

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

KV 500

g

2

DS1

Mutually Exclusive

MutEx(DS1.DS2)

Anchorage failure.

DS2

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

0.70



D5011.011a-DS1-1.JPG

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

NO

NO

Data Quality

Superior

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorages and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorages and concrete pad. Transformer tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.40E+03

2.20E+03

3.10E+03

3.76E+04

4.49E+04

5.97E+04

2.23E+03

Normal

1.00

5.00

1.00

5.00

2.42E+03

1.98E+03

4.94E+04

4.04E+04

0.30

0.30

Each

Each

0.19

0.19

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.34E+00

2.10E+00

2.96E+00

3.59E+00

4.29E+00

5.71E+00

2.10E+00

Normal

1.00

5.00

1.00

5.00

2.31E+00

1.89E+00

8.58E+00

2.15E+00

0.39

0.39

Each

Each

0.31

0.31

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

2.5E+02

Normal

0.39

1.0E+04

LogNormal

0.31

7.4E+03

Normal

0.39

1.9E+05

LogNormal

0.31

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

0%

0.00

NO

NO

0%

0.00

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

2016-10-25 Clarification of cost added.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5011.013h

Transformer/primary service - Capacity: 350 to <750 kVA - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment f

Line 595

Costing is per unit and is based upon 500 kVA.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

KV 500

Peak Floor Accelerationg

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

1.00

Damage State Probability:

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

3.05

0.6

0.1

0.5

Correlation (Yes / No)

NO

Data Quality

Superior

Documentation Quality

Superior

Directionality (Yes / No)

NO

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Service and repair existing transformer.
Transformer tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

3.62E+04

4.27E+04

5.66E+04

4.44E+04

LogNormal

1.00

5.00

4.70E+04

3.84E+04

0.18

0.18

Each

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

3.46E+00

4.08E+00

5.41E+00

4.08E+00

LogNormal

1.00

5.00

8.16E+00

2.04E+00

0.31

0.31

Each

Environmental Impacts:

Embodied Carbon (kg CO₂eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

1.0E+04

LogNormal

0.31

1.8E+05

LogNormal

0.31

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2016-10-25 Clarification of cost added.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5011.013i

Transformer/primary service - Capacity: 350 to <750 kVA - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

Costing is per unit and is based upon 500 kVA.

Line 596

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

KV 500

Peak Floor Acceleration g

3

DS1

Mutually Exclusive

MutEx(DS1,DS2,DS3)

Anchorage failure.

DS2

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

DS3

Mutually Exclusive

Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

0.35



D5011.011a-DS1-1.JPG

0.15

none

0.50

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β_t :

Correlation (Yes / No)

Directionality (Yes / No)

NO

NO

Data Quality Superior

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Transformer tower removed, repaired offsite, and reinstalled.

Service and repair existing transformer. Transformer tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

NO

YES

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.40E+03	2.20E+03	3.10E+03	3.76E+04	4.49E+04	5.97E+04	3.62E+04	4.27E+04	5.66E+04						
Best fit mean:	2.23E+03			4.65E+04			4.44E+04								
Best Fit Distribution:	Normal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00						
Average Repair Cost (Min Qty, Max Qty)	2.42E+03		1.98E+03	4.94E+04		4.04E+04	4.70E+04		3.84E+04						
CV or beta (Min Qty, Max Qty)	0.30		0.30	0.19		0.19	0.18		0.18						
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.34E+00	2.10E+00	2.96E+00	3.59E+00	4.29E+00	5.71E+00	3.46E+00	4.08E+00	5.41E+00						
Best fit mean:	2.10E+00			4.29E+00			4.08E+00								
Best Fit Distribution:	Normal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00						
Average Repair Time (Min Qty, Max Qty)	2.31E+00		1.89E+00	8.58E+00		2.15E+00	8.16E+00		2.04E+00						
CV or beta (Min Qty, Max Qty)	0.39		0.39	0.31		0.31	0.31		0.31						
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.5E+02	Normal	0.39	1.0E+04	LogNormal	0.31	1.0E+04	LogNormal	0.31						
Embodied Energy (MJ)	7.4E+03	Normal	0.39	1.9E+05	LogNormal	0.31	1.8E+05	LogNormal	0.31						
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			NO								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

2016-10-25 Clarification of cost added.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description


D5011.013j

Transformer/primary service - Capacity: 750 to 1500 kVA - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage f

Line 597

Costing is per unit and is based upon 1000 kVa.

Construction Quality:	Normal - Designed for seismic loads but no special seismic certification				
Seismic Installation Conditions:	Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints				
Fragility Unit of Measure:	KV 1000		Quantity Rounding		
Demand Parameter (unit):	Peak Floor Acceleration g		Round Qty? YES		
Number of Damage States:	2		Allow sum by floor or building? BLDG		
Damage State:	DS1	DS2	Demand Location (floor above?) No		
Type of Damage State:	Mutually Exclusive				
DS Hierarchy	MutEx(DS1.DS2)				
Descriptions	Anchorage failure.		Anchorage failure & Equipment damaged beyond repair.		

Illustrations					
	none				
Damage State Probability:	0.70	0.30			
Fragility Parameters					
Median Demand, θ :	By User	By User			
Data dispersion, β_d :	User to Calculate	User to Calculate			
Uncertainty, β_u :	User to Calculate	User to Calculate			
Total Dispersion, β :	By User	By User			
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Superior	
Directionality (Yes / No)	NO	Data Relevance Average		Rationality Superior	
Consequence Functions					
Repair Description	Repair anchorage and concrete pad and remount equipment. Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Transformer tower removed, repaired offsite, and reinstalled.				

Long Lead Time (Yes / No) NO YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.60E+03	2.40E+03	3.40E+03	4.91E+04	5.94E+04	7.82E+04									
Best fit mean:	2.36E+03			6.10E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00			1.00											
Average Repair Cost (Min Qty, Max Qty)	2.64E+03			6.53E+04											
CV or beta (Min Qty, Max Qty)	0.29			0.19											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.53E+00	2.29E+00	3.25E+00	3.29E+00	3.97E+00	5.23E+00									
Best fit mean:	2.29E+00			3.97E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00			1.00											
Average Repair Time (Min Qty, Max Qty)	2.52E+00			9.65E+00											
CV or beta (Min Qty, Max Qty)	0.38			0.31											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.5E+02	LogNormal	0.38	1.4E+04	LogNormal	0.31									
Embodied Energy (MJ)	7.4E+03	LogNormal	0.38	2.5E+05	LogNormal	0.31									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%			0%											
Loss of Life (Median, Dispersion)	0%			0%											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%			0%											

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Root Cost Multiplier: 1

Date Generated: 02/26/19

Not Given

By User

By User

Not Given

2016-10-25 Clarification of cost added.

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5011.013k

Transformer/primary service - Capacity: 750 to 1500 kVA - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment f

Line 598

Costing is per unit and is based upon 1000 kVa.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

KV 1000

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none				
1.00				

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

3.05

0.6

0.1

0.5

NO

NO

Data Quality

Superior

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions
Repair Description

Service and repair existing transformer.
Transformer tower removed, repaired offsite,
and reinstalled.

Long Lead Time (Yes / No)

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	4.75E+04	5.70E+04	7.48E+04												
Best fit mean:	5.87E+04														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Cost (Min Qty, Max Qty)	6.27E+04		5.13E+04												
CV or beta (Min Qty, Max Qty)	0.18		0.18												
Quantity Unit:	Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	3.18E+00	3.81E+00	5.01E+00												
Best fit mean:	3.81E+00														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Time (Min Qty, Max Qty)	9.26E+00		1.91E+00												
CV or beta (Min Qty, Max Qty)	0.31		0.31												
Quantity Unit:	Each														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.3E+04	LogNormal	0.31												
Embodied Energy (MJ)	2.4E+05	LogNormal	0.31												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%		0.00												
Loss of Life (Median, Dispersion)	0%		0.00												
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00												

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2016-10-25 Clarification of cost added.

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5011.013I

Transformer/primary service - Capacity: 750 to 1500 kVA - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

Costing is per unit and is based upon 1000 kVa.

Line 599

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

KV 1000

Peak Floor Acceleration g

3

DS1

Mutually Exclusive

MutEx(DS1,DS2,DS3)

Anchorage failure.

DS2

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

DS3

Mutually Exclusive

Damaged, Inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

0.35



D5011.011a-DS1-1.JPG

0.15

none

0.50

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

NO

NO

Data Quality Superior

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Transformer tower removed, repaired offsite, and reinstalled.

Service and repair existing transformer. Transformer tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

NO

YES

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.60E+03	2.40E+03	3.40E+03	4.91E+04	5.94E+04	7.82E+04	4.75E+04	5.70E+04	7.48E+04						
Best fit mean:	2.36E+03			6.10E+04			5.87E+04								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00			1.00 5.00								
Average Repair Cost (Min Qty, Max Qty)	2.64E+03 2.16E+03			6.53E+04 5.35E+04			6.27E+04 5.13E+04								
CV or beta (Min Qty, Max Qty)	0.29 0.29			0.19 0.19			0.18 0.18								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.53E+00	2.29E+00	3.25E+00	3.29E+00	3.97E+00	5.23E+00	3.18E+00	3.81E+00	5.01E+00						
Best fit mean:	2.29E+00			3.97E+00			3.81E+00								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00			1.00 5.00								
Average Repair Time (Min Qty, Max Qty)	2.52E+00 2.06E+00			9.65E+00 1.99E+00			9.26E+00 1.91E+00								
CV or beta (Min Qty, Max Qty)	0.38 0.38			0.31 0.31			0.31 0.31								
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.5E+02	LogNormal	0.38	1.4E+04	LogNormal	0.31	1.3E+04	LogNormal	0.31						
Embodied Energy (MJ)	7.4E+03	LogNormal	0.38	2.5E+05	LogNormal	0.31	2.4E+05	LogNormal	0.31						
LifeSafety Hazard:	Potential non-collapse casualties? (Yes / No)	Casualty-affected Planar Area (sf) per Normative Unit:	Serious Injury (Median, Dispersion)	Loss of Life (Median, Dispersion)	Post-event Tagging Flag:	Unsafe Placard Trigger (Median, Dispersion)									
	NO	Not Applicable	0% 0.00	0% 0.00	NO	0% 0.00	NO	0% 0.00	NO	0% 0.00					

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

2016-10-25 Clarification of cost added.

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.013a

Motor Control Center - Capacity: all - Unanchored equipment that is not vibration isolated - Equipment fragility only

Costing is per unit.

Line 600

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Unanchored equipment that is not vibration isolated

EA 1

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.00

0.73

0.45

0.1

0.45

NO

NO

Data Quality

Superior

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Replace equipment.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

3.20E+03

4.15E+03

5.15E+03

4.17E+03

Normal

5.00

4.57E+03

3.74E+03

0.18

0.18

Each

P₁₀

P₅₀

P₉₀

1.13E+00

1.46E+00

1.82E+00

1.46E+00

Normal

5.00

1.95E+00

9.76E-01

0.31

0.31

Each

Median Cost

Best Fit

CV or Beta

8.7E+02

Normal

0.31

Median Cost

Best Fit

CV or Beta

1.6E+04

Normal

0.31

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.013b

Motor Control Center - Capacity: all - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragility only

Costing is per unit.

Line 601

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

EA 1

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

Mutually Exclusive

MutEx(DS1.DS2)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

0.70



D5010.011a-DS1-1.JPG

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

NO

NO

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

Data Quality Superior

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Consequence Functions

Repair Description

Repair anchorages and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorages and concrete pad.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.00E+02	5.00E+02	6.50E+02	3.50E+03	4.65E+03	5.80E+03									
Best fit mean:	4.83E+02			4.65E+03											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	1.00			5.00			1.00			5.00					
Average Repair Cost (Min Qty, Max Qty)	5.50E+02			4.50E+02			5.12E+03			4.19E+03					
CV or beta (Min Qty, Max Qty)	0.28			0.28			0.19			0.19					
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	3.53E-01	5.88E-01	7.65E-01	8.24E-01	1.09E+00	1.36E+00									
Best fit mean:	5.88E-01			1.09E+00											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	1.00			5.00			1.00			5.00					
Average Repair Time (Min Qty, Max Qty)	6.47E-01			5.29E-01			1.64E+00			5.47E-01					
CV or beta (Min Qty, Max Qty)	0.38			0.38			0.32			0.32					
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.5E+01	Normal	0.38	9.3E+02	Normal	0.32									
Embodied Energy (MJ)	1.9E+03	Normal	0.38	1.8E+04	Normal	0.32									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.013c

Motor Control Center - Capacity: all - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragility only

Costing is per unit.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

EA 1

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

1.00

Damage State Probability:

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

2.5

0.4

0.1

0.4

Correlation (Yes / No)

NO

Data Quality

Superior

Documentation Quality

Superior

Directionality (Yes / No)

NO

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Replace equipment.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

3.20E+03

4.15E+03

5.15E+03

4.17E+03

Normal

1.00

5.00

4.57E+03

3.74E+03

0.18

0.18

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

3.76E+00

4.88E+00

6.06E+00

4.88E+00

Normal

1.00

5.00

5.37E+00

4.39E+00

0.31

0.31

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

8.7E+02

Normal

0.31

1.6E+04

Normal

0.31

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.		
Date Created:	Not Given	Root Cost Multiplier:	1
Approved (YES / NO)?	By User	Date Generated:	02/26/19
Official (YES / NO) ?	By User		
Author:	Not Given		
Revisions:	None		

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.021a

Low Voltage Switchgear - Capacity: 100 to <350 Amp - Unanchored equipment that is not vibration isolated - Equipment fragility only

Costing is per unit and is based upon 225 Amp.

Line604

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Unanchored equipment that is not vibration isolated

AP 225

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

FLR

Demand Location (floor above?)

No

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.28

0.4

0.1

0.4

NO

NO

Data Quality

Superior

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Replace insulator.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

8.20E+03

9.28E+03

1.21E+04

LogNormal

1.00

5.00

1.02E+04

8.35E+03

0.16

0.16

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.93E+00

2.18E+00

2.84E+00

LogNormal

1.00

5.00

3.27E+00

1.09E+00

0.30

0.30

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

2.0E+03

LogNormal

0.30

3.6E+04

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.021b

Low Voltage Switchgear - Capacity: 350 to <750 Amp - Unanchored equipment that is not vibration isolated - Equipment fragility only

Costing is per unit and is based upon 400 Amp.

Line605

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Unanchored equipment that is not vibration isolated

AP 400

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

FLR

Demand Location (floor above?)

No

Illustrations

none

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.00

1.28

0.4

0.1

0.4

NO

NO

Data Quality

Superior

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Replace insulator.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.47E+04

1.73E+04

1.73E+04

1.64E+04

Normal

1.00

5.00

1.90E+04

1.56E+04

0.06

0.06

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

2.59E+00

3.05E+00

3.05E+00

3.05E+00

Normal

1.00

5.00

5.09E+00

1.53E+00

0.26

0.26

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO₂eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

4.1E+03

Normal

0.26

7.1E+04

Normal

0.26

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.021c

Low Voltage Switchgear - Capacity: 750 to <1200 Amp - Unanchored equipment that is not vibration isolated - Equipment fragility only

Costing is per unit and is based upon 800 Amp.

Line 606

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Unanchored equipment that is not vibration isolated

AP 800

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

FLR

Demand Location (floor above?)

No

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.28

0.4

0.1

0.4

NO

NO

Data Quality

Superior

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Replace insulator.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.44E+04

2.96E+04

2.96E+04

2.79E+04

Normal

1.00

5.00

3.26E+04

2.66E+04

0.07

0.07

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.87E+00

3.48E+00

3.48E+00

3.48E+00

Normal

1.00

5.00

6.96E+00

1.74E+00

0.26

0.26

Each

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

7.2E+03

Normal

0.26

1.2E+05

Normal

0.26

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.021d

Low Voltage Switchgear - Capacity: 1200 to 2000 Amp - Unanchored equipment that is not vibration isolated - Equipment fragility only

Costing is per unit and is based upon 1600 Amp.

Line 607

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Unanchored equipment that is not vibration isolated

AP 1600

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

FLR

Demand Location (floor above?)

No

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.28

0.4

0.1

0.4

NO

NO

Data Quality

Superior

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Replace insulator.

Long Lead Time (Yes / No)

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

4.29E+04

5.14E+04

5.14E+04

4.86E+04

Normal

1.00

5.00

5.65E+04

4.63E+04

0.07

0.07

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

3.53E+00

4.23E+00

4.23E+00

4.23E+00

Normal

1.00

5.00

1.03E+01

2.12E+00

0.26

0.26

Each

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

1.2E+04

Normal

0.26

2.1E+05

Normal

0.26

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.023a

Low Voltage Switchgear - Capacity: 100 to <350 Amp - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragility
Costing is per unit and is based upon 225 Amp.

Line 608

Construction Quality:	Normal - Designed for seismic loads but no special seismic certification				
Seismic Installation Conditions:	Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints				
Fragility Unit of Measure:	AP 225		<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? FLR</div> <div>Demand Location (floor above?) No</div>		
Demand Parameter (unit):	Peak Floor Accelerationg				
Number of Damage States:	2				
Damage State:	DS1	DS2			
Type of Damage State:	Mutually Exclusive		Mutually Exclusive		
DS Hierarchy	MutEx(DS1,DS2)				
Descriptions	Anchorage failure.		Anchorage failure & Equipment damaged beyond repair.		

Illustrations					
	none	none			
Damage State Probability:	0.70	0.30			

Fragility Parameters					
Median Demand, θ :	By User	By User			
Data dispersion, β_d :	User to Calculate	User to Calculate			
Uncertainty, β_u :	User to Calculate	User to Calculate			
Total Dispersion, β :	By User	By User			
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Superior	
Directionality (Yes / No)	NO	Data Relevance Average		Rationality Superior	

Consequence Functions		
Repair Description	Repair anchorage and concrete pad and remount equipment.	Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Long Lead Time (Yes / No)	NO			NO														
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.00E+02	5.00E+02	6.50E+02	8.50E+03	9.78E+03	1.27E+04												
Best fit mean:	4.83E+02			1.02E+04														
Best Fit Distribution:	Normal			LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00	5.00		1.00	5.00													
Average Repair Cost (Min Qty, Max Qty)	5.50E+02	4.50E+02		1.08E+04	8.80E+03													
CV or beta (Min Qty, Max Qty)	0.28	0.28		0.16	0.16													
Quantity Unit:	Each			Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	3.53E-01	5.88E-01	7.65E-01	2.00E+00	2.30E+00	2.99E+00												
Best fit mean:	5.88E-01			2.30E+00														
Best Fit Distribution:	Normal			LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00	5.00		1.00	5.00													
Average Repair Time (Min Qty, Max Qty)	6.47E-01	5.29E-01		3.45E+00	1.15E+00													
CV or beta (Min Qty, Max Qty)	0.38	0.38		0.30	0.30													
Quantity Unit:	Each			Each														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.5E+01	Normal	0.38	2.1E+03	LogNormal	0.30												
Embodied Energy (MJ)	1.9E+03	Normal	0.38	3.8E+04	LogNormal	0.30												
LifeSafety Hazard:																		
Potential non-collapse casualties? (Yes / No)	NO			NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00													
Post-event Tagging Flag:	NO			NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00													

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.023b

Low Voltage Switchgear - Capacity: 100 to <350 Amp - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragil

Costing is per unit and is based upon 225 Amp.

Line 609

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

AP 225

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

FLR

Demand Location (floor above?)

No

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

2.4

0.4

0.1

0.4

NO

NO

Data Quality

Superior

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Replace fiberglass insulator supporting the vertical bus bars in the rear of the switchgear assembly

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

8.20E+03

9.28E+03

1.21E+04

9.71E+03

LogNormal

1.00

5.00

1.02E+04

8.35E+03

0.16

0.16

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.93E+00

2.18E+00

2.84E+00

2.18E+00

LogNormal

1.00

5.00

3.27E+00

1.09E+00

0.30

0.30

Each

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

2.0E+03

LogNormal

0.30

3.6E+04

LogNormal

0.30

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification	D5012.023c	Line 610
NISTIR Name	Low Voltage Switchgear - Capacity: 100 to <350 Amp - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anch	
Description	Costing is per unit and is based upon 225 Amp.	

Construction Quality:	Normal - Designed for seismic loads but no special seismic certification				
Seismic Installation Conditions:	Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints				
Fragility Unit of Measure:	AP 225	Quantity Rounding Round Qty? YES			
Demand Parameter (unit):	Peak Floor Acceleration g	Allow sum by floor or building? FLR			
Number of Damage States:	3	Demand Location (floor above?) No			
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive		
DS Hierarchy	MutEx(DS1,DS2,DS3)				
Descriptions	Anchorage failure.	Anchorage failure & Equipment damaged beyond repair.	Damaged, inoperative but anchorage is OK.		

Illustrations					
	none	none	none		
Damage State Probability:	0.35	0.15	0.50		
Fragility Parameters					
Median Demand, θ :	By User	By User	By User		
Data dispersion, β_d :	User to Calculate	User to Calculate	User to Calculate		
Uncertainty, β_u :	User to Calculate	User to Calculate	User to Calculate		
Total Dispersion, β :	By User	By User	By User		
Correlation (Yes / No)	NO	Data Quality Superior	Documentation Quality Superior		
Directionality (Yes / No)	NO	Data Relevance Average	Rationality Superior		
Consequence Functions					
Repair Description	Repair anchorage and concrete pad and remount equipment.	Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.	Replace fiberglass insulator supporting the vertical bus bars in the rear of the switchgear assembly		

Long Lead Time (Yes / No)	NO			NO			NO								
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.00E+02	5.00E+02	6.50E+02	8.50E+03	9.78E+03	1.27E+04	8.20E+03	9.28E+03	1.21E+04						
Best fit mean:	4.83E+02			1.02E+04			9.71E+03								
Best Fit Distribution:	Normal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00						
Average Repair Cost (Min Qty, Max Qty)	5.50E+02		4.50E+02	1.08E+04		8.80E+03	1.02E+04		8.35E+03						
CV or beta (Min Qty, Max Qty)	0.28		0.28	0.16		0.16	0.16		0.16						
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	3.53E-01	5.88E-01	7.65E-01	2.00E+00	2.30E+00	2.99E+00	1.93E+00	2.18E+00	2.84E+00						
Best fit mean:	5.88E-01			2.30E+00			2.18E+00								
Best Fit Distribution:	Normal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00						
Average Repair Time (Min Qty, Max Qty)	6.47E-01		5.29E-01	3.45E+00		1.15E+00	3.27E+00		1.09E+00						
CV or beta (Min Qty, Max Qty)	0.38		0.38	0.30		0.30	0.30		0.30						
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.5E+01	Normal	0.38	2.1E+03	LogNormal	0.30	2.0E+03	LogNormal	0.30						
Embodied Energy (MJ)	1.9E+03	Normal	0.38	3.8E+04	LogNormal	0.30	3.6E+04	LogNormal	0.30						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			NO								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							

Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.	
Date Created:	Not Given	Root Cost Multiplier: 1
Approved (YES / NO)?	By User	Date Generated: 02/26/19
Official (YES / NO) ?	By User	
Author:	Not Given	
Revisions:	None	

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.023d

Low Voltage Switchgear - Capacity: 350 to <750 Amp - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragility

Costing is per unit and is based upon 400 Amp.

Line 611

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

AP 400

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

MutEx(DS1.DS2)

Anchorage failure.

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

FLR

Demand Location (floor above?)

No

Illustrations

none

none

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.70

0.30

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

NO

NO

Data Quality

Superior

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

5.00E+02

8.00E+02

1.40E+03

1.52E+04

1.81E+04

2.41E+04

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

5.88E-01

9.41E-01

1.65E+00

2.68E+00

3.19E+00

4.25E+00

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

9.1E+01

LogNormal

0.48

4.2E+03

LogNormal

0.31

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.023e

Low Voltage Switchgear - Capacity: 350 to <750 Amp - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragil

Line 612

Costing is per unit and is based upon 400 Amp.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

AP 400

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

FLR

Demand Location (floor above?)

No

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

2.4

0.4

0.1

0.4

NO

NO

Data Quality Superior

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Consequence Functions

Repair Description

Replace fiberglass insulator supporting the vertical bus bars in the rear of the switchgear assembly

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P10P50P90

1.47E+041.73E+041.73E+04

1.64E+04Normal

1.005.00

1.90E+041.56E+04

0.060.06

Each

P10P50P90

2.59E+003.05E+003.05E+00

3.05E+00Normal

1.005.00

5.09E+001.53E+00

0.260.26

Each

Median CostBest FitCV or Beta

4.1E+03Normal0.26

7.1E+04Normal0.26

NO

Not Applicable

0%0.00

0%0.00

NO

0%0.00

Median CostBest FitCV or Beta

Median CostBest FitCV or Beta

Median CostBest FitCV or Beta

Median CostBest FitCV or Beta

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification	D5012.023f	Line 613
NISTIR Name	Low Voltage Switchgear - Capacity: 350 to <750 Amp - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anch	
Description	Costing is per unit and is based upon 400 Amp.	

Construction Quality:	Normal - Designed for seismic loads but no special seismic certification				
Seismic Installation Conditions:	Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints				
Fragility Unit of Measure:	AP 400		Quantity Rounding Round Qty? YES		
Demand Parameter (unit):	Peak Floor Acceleration g		Allow sum by floor or building? FLR		
Number of Damage States:	3		Demand Location (floor above?) No		
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Mutually Exclusive		Mutually Exclusive		
DS Hierarchy	MutEx(DS1,DS2,DS3)				
Descriptions	Anchorage failure.	Anchorage failure & Equipment damaged beyond repair.	Damaged, inoperative but anchorage is OK.		

Illustrations					
	none	none	none		
Damage State Probability:	0.35	0.15	0.50		

Fragility Parameters					
Median Demand, θ :	By User	By User	By User		
Data dispersion, β_d :	User to Calculate	User to Calculate	User to Calculate		
Uncertainty, β_u :	User to Calculate	User to Calculate	User to Calculate		
Total Dispersion, β :	By User	By User	By User		
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Superior	
Directionality (Yes / No)	NO	Data Relevance Average		Rationality Superior	

Consequence Functions					
Repair Description	Repair anchorage and concrete pad and remount equipment.	Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.	Replace fiberglass insulator supporting the vertical bus bars in the rear of the switchgear assembly		

Long Lead Time (Yes / No)	NO			NO			NO								
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	5.00E+02	8.00E+02	1.40E+03	1.52E+04	1.81E+04	2.41E+04	1.47E+04	1.73E+04	1.73E+04						
Best fit mean:	8.20E+02			1.88E+04			1.64E+04								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	1.00	5.00		1.00	5.00		1.00	5.00							
Average Repair Cost (Min Qty, Max Qty)	8.80E+02	7.20E+02		1.99E+04	1.63E+04		1.90E+04	1.56E+04							
CV or beta (Min Qty, Max Qty)	0.41	0.41		0.19	0.19		0.06	0.06							
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.88E-01	9.41E-01	1.65E+00	2.68E+00	3.19E+00	4.25E+00	2.59E+00	3.05E+00	3.05E+00						
Best fit mean:	9.41E-01			3.19E+00			3.05E+00								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	1.00	5.00		1.00	5.00		1.00	5.00							
Average Repair Time (Min Qty, Max Qty)	1.04E+00	8.47E-01		5.32E+00	1.60E+00		5.09E+00	1.53E+00							
CV or beta (Min Qty, Max Qty)	0.48	0.48		0.31	0.31		0.26	0.26							
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	9.1E+01	LogNormal	0.48	4.2E+03	LogNormal	0.31	4.1E+03	Normal	0.26						
Embodied Energy (MJ)	2.6E+03	LogNormal	0.48	7.3E+04	LogNormal	0.31	7.1E+04	Normal	0.26						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			NO								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							

Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.			
Date Created:	Not Given	Root Cost Multiplier:	1	
Approved (YES / NO)?	By User	Date Generated:	02/26/19	
Official (YES / NO) ?	By User			
Author:	Not Given			
Revisions:	None			

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.023g

Low Voltage Switchgear - Capacity: 750 to <1200 Amp - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage frag

Costing is per unit and is based upon 800 Amp.

Line 614

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

AP 800

g

2

DS1

DS2

Mutually Exclusive

Mutually Exclusive

MutEx(DS1.DS2)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?	FLR	
Demand Location (floor above?)	No	

Illustrations

none	none			
0.70	0.30			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	By User	By User			
Data dispersion, β_d :	User to Calculate	User to Calculate			
Uncertainty, β_u :	User to Calculate	User to Calculate			
Total Dispersion, β :	By User	By User			
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Superior	
Directionality (Yes / No)	NO	Data Relevance Average		Rationality Superior	

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	9.00E+02	1.20E+03	2.00E+03	2.53E+04	3.08E+04	4.10E+04									
Best fit mean:	1.28E+03			3.17E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00			1.00											
Average Repair Cost (Min Qty, Max Qty)	1.32E+03			3.39E+04											
CV or beta (Min Qty, Max Qty)	0.34			0.19											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.06E+00	1.41E+00	2.35E+00	2.98E+00	3.62E+00	4.82E+00									
Best fit mean:	1.41E+00			3.62E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00			1.00											
Average Repair Time (Min Qty, Max Qty)	1.55E+00			7.25E+00											
CV or beta (Min Qty, Max Qty)	0.42			0.32											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.3E+02	LogNormal	0.42	7.4E+03	LogNormal	0.32									
Embodied Energy (MJ)	3.8E+03	LogNormal	0.42	1.3E+05	LogNormal	0.32									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.023h

Low Voltage Switchgear - Capacity: 750 to <1200 Amp - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment frag
Costing is per unit and is based upon 800 Amp.

Line 615

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

AP 800

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

FLR

Demand Location (floor above?)

No

Illustrations

none				
1.00				

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

2.4

0.4

0.1

0.4

NO

NO

Data Quality

Data Relevance

Superior

Average

Documentation Quality

Rationality

Superior

Superior

Consequence Functions

Repair Description

Replace fiberglass insulator supporting the vertical bus bars in the rear of the switchgear assembly

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.44E+04	2.96E+04	2.96E+04												
Best fit mean:	2.79E+04														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Cost (Min Qty, Max Qty)	3.26E+04		2.66E+04												
CV or beta (Min Qty, Max Qty)	0.07		0.07												
Quantity Unit:	Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.87E+00	3.48E+00	3.48E+00												
Best fit mean:	3.48E+00														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Time (Min Qty, Max Qty)	6.96E+00		1.74E+00												
CV or beta (Min Qty, Max Qty)	0.26		0.26												
Quantity Unit:	Each														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	7.2E+03	Normal	0.26												
Embodied Energy (MJ)	1.2E+05	Normal	0.26												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification	D5012.023i	Line 616
NISTIR Name	Low Voltage Switchgear - Capacity: 750 to <1200 Amp - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anch	
Description	Costing is per unit and is based upon 800 Amp.	

Construction Quality:	Normal - Designed for seismic loads but no special seismic certification				
Seismic Installation Conditions:	Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints				
Fragility Unit of Measure:	AP 800		Quantity Rounding Round Qty? YES		
Demand Parameter (unit):	Peak Floor Acceleration g		Allow sum by floor or building? FLR		
Number of Damage States:	3		Demand Location (floor above?) No		
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Mutually Exclusive		Mutually Exclusive		
DS Hierarchy	MutEx(DS1,DS2,DS3)				
Descriptions	Anchorage failure.		Anchorage failure & Equipment damaged beyond repair.		
			Damaged, inoperative but anchorage is OK.		

Illustrations					
	none	none	none		
Damage State Probability:	0.35	0.15	0.50		

Fragility Parameters					
Median Demand, θ :	By User	By User	By User		
Data dispersion, β_d :	User to Calculate	User to Calculate	User to Calculate		
Uncertainty, β_u :	User to Calculate	User to Calculate	User to Calculate		
Total Dispersion, β :	By User	By User	By User		
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Superior	
Directionality (Yes / No)	NO	Data Relevance Average		Rationality Superior	

Consequence Functions					
Repair Description	Repair anchorage and concrete pad and remount equipment.	Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.	Replace fiberglass insulator supporting the vertical bus bars in the rear of the switchgear assembly		

Long Lead Time (Yes / No)	NO			NO			NO											
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀			
Repair Cost by Damage State:	9.00E+02	1.20E+03	2.00E+03	2.53E+04	3.08E+04	4.10E+04	2.44E+04	2.96E+04	2.96E+04									
Best fit mean:	1.28E+03			3.17E+04			2.79E+04											
Best Fit Distribution:	LogNormal			LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	1.00	5.00		1.00	5.00		1.00	5.00										
Average Repair Cost (Min Qty, Max Qty)	1.32E+03	1.08E+03		3.39E+04	2.77E+04		3.26E+04	2.66E+04										
CV or beta (Min Qty, Max Qty)	0.34	0.34		0.19	0.19		0.07	0.07										
Quantity Unit:	Each			Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀			
Repair Time by Damage State:	1.06E+00	1.41E+00	2.35E+00	2.98E+00	3.62E+00	4.82E+00	2.87E+00	3.48E+00	3.48E+00									
Best fit mean:	1.41E+00			3.62E+00			3.48E+00											
Best Fit Distribution:	LogNormal			LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	1.00	5.00		1.00	5.00		1.00	5.00										
Average Repair Time (Min Qty, Max Qty)	1.55E+00	1.27E+00		7.25E+00	1.81E+00		6.96E+00	1.74E+00										
CV or beta (Min Qty, Max Qty)	0.42	0.42		0.32	0.32		0.26	0.26										
Quantity Unit:	Each			Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta			
Embodied Carbon (kg CO2eq)	1.3E+02	LogNormal	0.42	7.4E+03	LogNormal	0.32	7.2E+03	Normal	0.26									
Embodied Energy (MJ)	3.8E+03	LogNormal	0.42	1.3E+05	LogNormal	0.32	1.2E+05	Normal	0.26									
LifeSafety Hazard:																		
Potential non-collapse casualties? (Yes / No)	NO			NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00										

Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.				
Date Created:	Not Given		Root Cost Multiplier: 1		
Approved (YES / NO)?	By User		Date Generated: 02/26/19		
Official (YES / NO) ?	By User				
Author:	Not Given				
Revisions:	None				

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.023j

Low Voltage Switchgear - Capacity: 1200 to 2000 Amp - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage frag

Line 617

Costing is per unit and is based upon 1600 Amp.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

AP 1600

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

Mutually Exclusive

MutEx(DS1.DS2)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

FLR

Demand Location (floor above?)

No

Illustrations

none	none			
0.70	0.30			

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

NO

NO

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

Data Quality Superior

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	9.00E+02	1.20E+03	2.00E+03	4.38E+04	5.26E+04	6.95E+04									
Best fit mean:	1.28E+03			5.43E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00			5.00											
Average Repair Cost (Min Qty, Max Qty)	1.32E+03			5.79E+04			4.73E+04								
CV or beta (Min Qty, Max Qty)	0.34			0.19			0.19								
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.06E+00	1.41E+00	2.35E+00	3.61E+00	4.33E+00	5.72E+00									
Best fit mean:	1.41E+00			4.33E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00			5.00											
Average Repair Time (Min Qty, Max Qty)	1.55E+00			1.05E+01			2.17E+00								
CV or beta (Min Qty, Max Qty)	0.42			0.31			0.31								
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.3E+02	LogNormal	0.42	1.2E+04	LogNormal	0.31									
Embodied Energy (MJ)	3.8E+03	LogNormal	0.42	2.2E+05	LogNormal	0.31									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.023k

Low Voltage Switchgear - Capacity: 1200 to 2000 Amp - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment frag

Line 618

Costing is per unit and is based upon 1600 Amp.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

AP 1600

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

FLR

Demand Location (floor above?)

No

Illustrations

none				
1.00				

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

2.4

0.4

0.1

0.4

NO

NO

Data Quality

Superior

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Replace fiberglass insulator supporting the vertical bus bars in the rear of the switchgear assembly

Long Lead Time (Yes / No) YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	4.29E+04	5.14E+04	5.14E+04												
Best fit mean:	4.86E+04														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Cost (Min Qty, Max Qty)	5.65E+04		4.63E+04												
CV or beta (Min Qty, Max Qty)	0.07		0.07												
Quantity Unit:	Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	3.53E+00	4.23E+00	4.23E+00												
Best fit mean:	4.23E+00														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Time (Min Qty, Max Qty)	1.03E+01		2.12E+00												
CV or beta (Min Qty, Max Qty)	0.26		0.26												
Quantity Unit:	Each														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.2E+04	Normal	0.26												
Embodied Energy (MJ)	2.1E+05	Normal	0.26												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.023I

Low Voltage Switchgear - Capacity: 1200 to 2000 Amp - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anch

Costing is per unit and is based upon 1600 Amp.

Line 619

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

AP 1600

Peak Floor Acceleration

g

3

DS1

Mutually Exclusive

MutEx(DS1,DS2,DS3)

Anchorage failure.

DS2

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

DS3

Mutually Exclusive

Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

FLR

Demand Location (floor above?)

No

Illustrations

none

0.35

none

0.15

none

0.50

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

User to Calculate

By User

NO

Data Quality Superior

Documentation Quality Superior

NO

Data Relevance Average

Rationality Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Replace fiberglass insulator supporting the vertical bus bars in the rear of the switchgear assembly

Long Lead Time (Yes / No)

NO

YES

YES

Repair Costs:

Repair Time:

Environmental Impacts:

LifeSafety Hazard:

P₁₀

P₅₀

P₉₀

9.00E+02

1.20E+03

2.00E+03

P₁₀

P₅₀

P₉₀

4.38E+04

5.26E+04

6.95E+04

P₁₀

P₅₀

P₉₀

4.29E+04

5.14E+04

5.14E+04

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

1.28E+03

LogNormal

1.00

5.00

1.32E+03

1.08E+03

0.34

0.34

Each

5.43E+04

LogNormal

1.00

5.00

5.79E+04

4.73E+04

0.19

0.19

Each

4.86E+04

Normal

1.00

5.00

5.65E+04

4.63E+04

0.07

0.07

Each

P₁₀

P₅₀

P₉₀

1.06E+00

1.41E+00

2.35E+00

P₁₀

P₅₀

P₉₀

3.61E+00

4.33E+00

5.72E+00

P₁₀

P₅₀

P₉₀

3.53E+00

4.23E+00

4.23E+00

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

1.41E+00

LogNormal

1.00

5.00

1.55E+00

1.27E+00

0.42

0.42

Each

4.33E+00

LogNormal

1.00

5.00

1.05E+01

2.17E+00

0.31

0.31

Each

4.23E+00

Normal

1.00

5.00

1.03E+01

2.12E+00

0.26

0.26

Each

Median Cost

Best Fit

CV or Beta

1.3E+02

LogNormal

0.42

Median Cost

Best Fit

CV or Beta

1.2E+04

LogNormal

0.31

Median Cost

Best Fit

CV or Beta

1.2E+04

Normal

0.26

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

1.3E+02

LogNormal

0.42

3.8E+03

LogNormal

0.42

1.2E+04

LogNormal

0.31

2.2E+05

LogNormal

0.31

1.2E+04

Normal

0.26

2.1E+05

Normal

0.26

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

1

02/26/19

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.031b

Distribution Panel - Capacity: 350 to <750 Amp - Unanchored equipment that is not vibration isolated - Equipment fragility only

Costing is per unit and is based upon 400 Amp.

Line 621

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Unanchored equipment that is not vibration isolated

AP 400

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D5012.031b-DS1-1.JPG

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

NO

NO

Data Quality Superior

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Consequence Functions

Repair Description

Replace equipment

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.47E+04

1.73E+04

1.73E+04

1.64E+04

Normal

1.00

5.00

2.25E+04

1.56E+04

0.06

0.06

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

2.59E+00

3.05E+00

3.05E+00

3.05E+00

Normal

1.00

5.00

9.16E+00

1.53E+00

0.26

0.26

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO₂eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

4.1E+03

Normal

0.26

7.1E+04

Normal

0.26

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.031c

Distribution Panel - Capacity: 750 to <1200 Amp - Unanchored equipment that is not vibration isolated - Equipment fragility only

Costing is per unit and is based upon 800 Amp.

Line 622

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Unanchored equipment that is not vibration isolated

AP 800

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D5012.031b-DS1-1.JPG

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.00

2.16

0.4

0.25

0.45

NO

NO

Data Quality

Data Relevance

Superior

Average

Documentation Quality

Rationality

Superior

Superior

Consequence Functions

Repair Description

Replace equipment

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

2.44E+04

2.96E+04

2.96E+04

2.79E+04

Normal

1.00

5.00

3.85E+04

2.66E+04

0.07

0.07

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

2.87E+00

3.48E+00

3.48E+00

3.48E+00

Normal

1.00

5.00

1.39E+01

1.74E+00

0.26

0.26

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO₂eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

7.2E+03

Normal

0.26

1.2E+05

Normal

0.26

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.031d

Distribution Panel - Capacity: 1200 to 2000 Amp - Unanchored equipment that is not vibration isolated - Equipment fragility only

Costing is per unit and is based upon 1600 Amp.

Line 623

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Unanchored equipment that is not vibration isolated

AP 1600

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D5012.031b-DS1-1.JPG

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Consequence Functions

Repair Description

1.00

2.16

0.4

0.25

0.45

NO

NO

Replace equipment

Data Quality Superior

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Long Lead Time (Yes / No)

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

4.29E+04

5.14E+04

5.14E+04

4.86E+04

Normal

1.00

5.00

6.68E+04

4.63E+04

0.07

0.07

Each

P₁₀

P₅₀

P₉₀

3.53E+00

4.23E+00

4.23E+00

4.23E+00

Normal

1.00

5.00

2.24E+01

2.12E+00

0.26

0.26

Each

Median Cost

Best Fit

CV or Beta

1.2E+04

Normal

0.26

2.1E+05

Normal

0.26

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.033a

Distribution Panel - Capacity: 100 to <350 Amp - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragility only
Costing is per unit and is based upon 225 Amp.

Line 624

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification
Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints
AP 225
Peak Floor Acceleration g
2
DS1DS2
Mutually Exclusive
Mutually Exclusive
MutEx(DS1.DS2)
Anchorage failure.
Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none	none			
0.70	0.30			

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

NO

NO

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

Data Quality Superior

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Consequence Functions
Repair Description

Repair anchorage and concrete pad (if floor mounted and wall if wall mounted) and remount equipment.

Replace equipment in addition to repairing anchorage and concrete pad if floor mounted or wall if wall mounted.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.00E+02	5.00E+02	6.50E+02	8.50E+03	9.78E+03	1.27E+04									
Best fit mean:	4.83E+02			1.02E+04											
Best Fit Distribution:	Normal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00			5.00											
Average Repair Cost (Min Qty, Max Qty)	6.50E+02			4.50E+02			1.27E+04			8.80E+03					
CV or beta (Min Qty, Max Qty)	0.28			0.28			0.16			0.16					
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	3.53E-01	5.88E-01	7.65E-01	2.00E+00	2.30E+00	2.99E+00									
Best fit mean:	5.88E-01			2.30E+00											
Best Fit Distribution:	Normal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00			5.00			1.00			5.00					
Average Repair Time (Min Qty, Max Qty)	7.64E-01			5.29E-01			5.75E+00			1.15E+00					
CV or beta (Min Qty, Max Qty)	0.38			0.38			0.30			0.30					
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.5E+01	Normal	0.38	2.1E+03	LogNormal	0.30									
Embodied Energy (MJ)	1.9E+03	Normal	0.38	3.8E+04	LogNormal	0.30									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.
Not Given
By User
By User
Not Given
None

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.033b

Distribution Panel - Capacity: 100 to <350 Amp - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

Line 625

Equipment fragility onl

Costing is per unit and is based upon 225 Amp.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

AP 225

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations



Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.00

3.05

0.4

0.1

0.4

NO

NO

Data Quality

Superior

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Replace equipment

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	8.20E+03	9.28E+03	1.21E+04												
Best fit mean:	9.71E+03														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Cost (Min Qty, Max Qty)	1.11E+04		7.42E+03												
CV or beta (Min Qty, Max Qty)	0.16		0.16												
Quantity Unit:	Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.17E+00	2.46E+00	3.19E+00												
Best fit mean:	2.46E+00														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Time (Min Qty, Max Qty)	4.91E+00		1.23E+00												
CV or beta (Min Qty, Max Qty)	0.30		0.30												
Quantity Unit:	Each														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	2.0E+03	LogNormal	0.30												
Embodied Energy (MJ)	3.6E+04	LogNormal	0.30												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification	D5012.033c	Line 626
NISTIR Name	Distribution Panel - Capacity: 100 to <350 Amp - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage/	
Description	Costing is per unit and is based upon 225 Amp.	

Construction Quality:	Normal - Designed for seismic loads but no special seismic certification				
Seismic Installation Conditions:	Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints				
Fragility Unit of Measure:	AP 225	Quantity Rounding Round Qty? YES			
Demand Parameter (unit):	Peak Floor Acceleration g	Allow sum by floor or building? BLDG			
Number of Damage States:	3	Demand Location (floor above?) No			
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive		
DS Hierarchy	MutEx(DS1,DS2,DS3)				
Descriptions	Anchorage failure.	Anchorage failure & Equipment damaged beyond repair.	Damaged, Inoperative but anchorage is OK.		

Illustrations					
	none	none	none		
	0.35	0.15	0.50		
Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	By User	By User	By User		
Data dispersion, β_d :	User to Calculate	User to Calculate	User to Calculate		
Uncertainty, β_u :	User to Calculate	User to Calculate	User to Calculate		
Total Dispersion, β :	By User	By User	By User		
Correlation (Yes / No)	NO	Data Quality Superior	Documentation Quality Superior		
Directionality (Yes / No)	NO	Data Relevance Average	Rationality Superior		

Consequence Functions					
Repair Description	Repair anchorage and concrete pad (if floor mounted and wall if wall mounted) and remount equipment.	Replace equipment in addition to repairing anchorage and concrete pad if floor mounted or wall if wall mounted.	Replace equipment.		

Long Lead Time (Yes / No)	NO			NO			NO											
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.00E+02	5.00E+02	6.50E+02	8.50E+03	9.78E+03	1.27E+04	8.20E+03	9.28E+03	1.21E+04									
Best fit mean:	4.83E+02			1.02E+04			9.71E+03											
Best Fit Distribution:	Normal			LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00									
Average Repair Cost (Min Qty, Max Qty)	6.00E+02		4.00E+02	1.17E+04		7.82E+03	1.11E+04		7.42E+03									
CV or beta (Min Qty, Max Qty)	0.28		0.28	0.16		0.16	0.16		0.16									
Quantity Unit:	Each			Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	3.97E-01	6.62E-01	8.60E-01	2.25E+00	2.59E+00	3.36E+00	2.17E+00	2.46E+00	3.19E+00									
Best fit mean:	6.62E-01			2.59E+00			2.46E+00											
Best Fit Distribution:	Normal			LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00									
Average Repair Time (Min Qty, Max Qty)	7.94E-01		5.29E-01	5.18E+00		1.29E+00	4.91E+00		1.23E+00									
CV or beta (Min Qty, Max Qty)	0.38		0.38	0.30		0.30	0.30		0.30									
Quantity Unit:	Each			Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.5E+01	Normal	0.38	2.1E+03	LogNormal	0.30	2.0E+03	LogNormal	0.30									
Embodied Energy (MJ)	1.9E+03	Normal	0.38	3.8E+04	LogNormal	0.30	3.6E+04	LogNormal	0.30									
LifeSafety Hazard:																		
Potential non-collapse casualties? (Yes / No)	NO			NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00										

Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.	
Date Created:	Not Given	Root Cost Multiplier: 1
Approved (YES / NO)?	By User	Date Generated: 02/26/19
Official (YES / NO) ?	By User	
Author:	Not Given	
Revisions:	None	

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.033d

Distribution Panel - Capacity: 350 to <750 Amp - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragility only
Costing is per unit and is based upon 400 Amp.

Line 627

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

AP 400

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

Mutually Exclusive

MutEx(DS1.DS2)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none	none			
0.70	0.30			

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

NO

NO

Data Quality

Superior

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions
Repair Description

Repair anchorage and concrete pad (if floor mounted and wall if wall mounted) and remount equipment.

Replace equipment in addition to repairing anchorage and concrete pad if floor mounted or wall if wall mounted.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	5.00E+02	8.00E+02	1.40E+03	1.52E+04	1.81E+04	2.41E+04									
Best fit mean:	8.20E+02			1.88E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00			1.00											
Average Repair Cost (Min Qty, Max Qty)	1.04E+03			2.35E+04											
CV or beta (Min Qty, Max Qty)	0.41			0.19											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.88E-01	9.41E-01	1.65E+00	2.68E+00	3.19E+00	4.25E+00									
Best fit mean:	9.41E-01			3.19E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00			1.00											
Average Repair Time (Min Qty, Max Qty)	1.22E+00			9.58E+00											
CV or beta (Min Qty, Max Qty)	0.48			0.31											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	9.1E+01	LogNormal	0.48	4.2E+03	LogNormal	0.31									
Embodied Energy (MJ)	2.6E+03	LogNormal	0.48	7.3E+04	LogNormal	0.31									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.033e

Distribution Panel - Capacity: 350 to <750 Amp - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragility onl
Costing is per unit and is based upon 400 Amp.

Line 628

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

AP 400

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations



Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.00

3.05

0.4

0.1

0.4

NO

NO

Data Quality

Superior

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Replace equipment

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.47E+04	1.73E+04	1.73E+04												
Best fit mean:	1.64E+04														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	1.00														
Average Repair Cost (Min Qty, Max Qty)	2.08E+04														
CV or beta (Min Qty, Max Qty)	0.06														
Quantity Unit:	Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.92E+00	3.43E+00	3.43E+00												
Best fit mean:	3.43E+00														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	1.00														
Average Repair Time (Min Qty, Max Qty)	8.01E+00														
CV or beta (Min Qty, Max Qty)	0.26														
Quantity Unit:	Each														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	4.1E+03	Normal	0.26												
Embodied Energy (MJ)	7.1E+04	Normal	0.26												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%														
Loss of Life (Median, Dispersion)	0%														
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%														

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.033f

Distribution Panel - Capacity: 350 to <750 Amp - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage/

Costing is per unit and is based upon 400 Amp.

Line 629

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

AP 400

Peak Floor Acceleration

g

3

DS1

Mutually Exclusive

MutEx(DS1,DS2,DS3)

Anchorage failure.

DS2

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

DS3

Mutually Exclusive

Damaged, Inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

0.35

none

0.15

none

0.50

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

NO

NO

Data Quality

Superior

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad (if floor mounted and wall if wall mounted) and remount equipment.

Replace equipment in addition to repairing anchorage and concrete pad if floor mounted or wall if wall mounted.

Replace equipment.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Time:

Environmental Impacts:

LifeSafety Hazard:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

5.00E+02

8.00E+02

1.40E+03

LogNormal

1.00

5.00

9.60E+02

6.40E+02

0.41

0.41

Each

P₁₀

P₅₀

P₉₀

1.52E+04

1.81E+04

2.41E+04

LogNormal

1.00

5.00

2.17E+04

1.45E+04

0.19

0.19

Each

P₁₀

P₅₀

P₉₀

1.47E+04

1.73E+04

1.73E+04

Normal

1.00

5.00

2.08E+04

1.38E+04

0.06

0.06

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

6.62E-01

1.06E+00

1.85E+00

LogNormal

1.00

5.00

1.27E+00

8.47E-01

0.48

0.48

Each

P₁₀

P₅₀

P₉₀

3.02E+00

3.59E+00

4.78E+00

LogNormal

1.00

5.00

8.38E+00

1.80E+00

0.31

0.31

Each

P₁₀

P₅₀

P₉₀

2.92E+00

3.43E+00

3.43E+00

Normal

1.00

5.00

8.01E+00

1.72E+00

0.26

0.26

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

9.1E+01

LogNormal

0.48

4.2E+03

LogNormal

0.31

4.1E+03

Normal

0.26

2.6E+03

LogNormal

0.48

7.3E+04

LogNormal

0.31

7.1E+04

Normal

0.26

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

Not Applicable

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.033g

Distribution Panel - Capacity: 750 to <1200 Amp - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragility or
Costing is per unit and is based upon 800 Amp.

Line 630

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

AP 800

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

Mutually Exclusive

MutEx(DS1.DS2)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none	none			
0.70	0.30			

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

NO

NO

Data Quality

Superior

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions
Repair Description

Repair anchorage and concrete pad (if floor mounted and wall if wall mounted) and remount equipment.

Replace equipment in addition to repairing anchorage and concrete pad if floor mounted or wall if wall mounted.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	9.00E+02	1.20E+03	2.00E+03	2.53E+04	3.08E+04	4.10E+04									
Best fit mean:	1.28E+03			3.17E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00			1.00											
Average Repair Cost (Min Qty, Max Qty)	1.56E+03			4.00E+04											
CV or beta (Min Qty, Max Qty)	0.34			0.19											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.06E+00	1.41E+00	2.35E+00	2.98E+00	3.62E+00	4.82E+00									
Best fit mean:	1.41E+00			3.62E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00			1.00											
Average Repair Time (Min Qty, Max Qty)	1.84E+00			1.45E+01											
CV or beta (Min Qty, Max Qty)	0.42			0.32											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.3E+02	LogNormal	0.42	7.4E+03	LogNormal	0.32									
Embodied Energy (MJ)	3.8E+03	LogNormal	0.42	1.3E+05	LogNormal	0.32									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.033h

Distribution Panel - Capacity: 750 to <1200 Amp - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragility or Costing is per unit and is based upon 800 Amp.

Line 63.1

Construction Quality: Normal - Designed for seismic loads but no special seismic certification

Seismic Installation Conditions: Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

Fragility Unit of Measure: AP 800

Demand Parameter (unit): Peak Floor Acceleration g

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy: Seq(DS1)

Descriptions: Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building? BLDG

Demand Location (floor above?) No

Illustrations



Damage State Probability: 1.00

Fragility Parameters

Median Demand, θ : 3.05

Data dispersion, β_d : 0.4

Uncertainty, β_u : 0.1

Total Dispersion, β : 0.4

Correlation (Yes / No) NO

Directionality (Yes / No) NO

Data Quality Superior

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Consequence Functions

Repair Description: Replace equipment

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.44E+04	2.96E+04	2.96E+04												
Best fit mean:	2.79E+04														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00														
Average Repair Cost (Min Qty, Max Qty)	3.55E+04 2.37E+04														
CV or beta (Min Qty, Max Qty)	0.07 0.07														
Quantity Unit:	Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	3.23E+00	3.92E+00	3.92E+00												
Best fit mean:	3.92E+00														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00														
Average Repair Time (Min Qty, Max Qty)	1.18E+01 1.96E+00														
CV or beta (Min Qty, Max Qty)	0.26 0.26														
Quantity Unit:	Each														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	7.2E+03	Normal	0.26												
Embodied Energy (MJ)	1.2E+05	Normal	0.26												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0% 0.00														
Loss of Life (Median, Dispersion)	0% 0.00														
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00														

Comments: None

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Not Given

Revisions: None

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification	D5012.033i	Line 632
NISTIR Name	Distribution Panel - Capacity: 750 to <1200 Amp - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage	
Description	Costing is per unit and is based upon 800 Amp.	

Construction Quality:	Normal - Designed for seismic loads but no special seismic certification			
Seismic Installation Conditions:	Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints			
Fragility Unit of Measure:	AP 800	Quantity Rounding Round Qty? YES		
Demand Parameter (unit):	Peak Floor Acceleration g	Allow sum by floor or building? BLDG		
Number of Damage States:	3	Demand Location (floor above?) No		
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive	
DS Hierarchy	MutEx(DS1,DS2,DS3)			
Descriptions	Anchorage failure.	Anchorage failure & Equipment damaged beyond repair.	Damaged, Inoperative but anchorage is OK.	

Illustrations					
	none	none	none		
	0.35	0.15	0.50		
Damage State Probability:					
Fragility Parameters					
Median Demand, θ:	By User	By User	By User		
Data dispersion, β_d:	User to Calculate	User to Calculate	User to Calculate		
Uncertainty, β_u:	User to Calculate	User to Calculate	User to Calculate		
Total Dispersion, β:	By User	By User	By User		
Correlation (Yes / No)	NO	Data Quality Superior	Documentation Quality Superior		
Directionality (Yes / No)	NO	Data Relevance Average	Rationality Superior		

Consequence Functions			
Repair Description	Repair anchorage and concrete pad (if floor mounted and wall if wall mounted) and remount equipment.	Replace equipment in addition to repairing anchorage and concrete pad if floor mounted or wall if wall mounted.	Replace equipment.

Long Lead Time (Yes / No)	NO			NO			NO								
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	9.00E+02	1.20E+03	2.00E+03	2.53E+04	3.08E+04	4.10E+04	2.44E+04	2.96E+04	2.96E+04						
Best fit mean:	1.28E+03			3.17E+04			2.79E+04								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00						
Average Repair Cost (Min Qty, Max Qty)	1.44E+03		9.60E+02	3.70E+04		2.46E+04	3.55E+04		2.37E+04						
CV or beta (Min Qty, Max Qty)	0.34		0.34	0.19		0.19	0.07		0.07						
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.19E+00	1.59E+00	2.65E+00	3.35E+00	4.08E+00	5.43E+00	3.23E+00	3.92E+00	3.92E+00						
Best fit mean:	1.59E+00			4.08E+00			3.92E+00								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00						
Average Repair Time (Min Qty, Max Qty)	1.91E+00		1.27E+00	1.22E+01		2.04E+00	1.18E+01		1.96E+00						
CV or beta (Min Qty, Max Qty)	0.42		0.42	0.32		0.32	0.26		0.26						
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.3E+02	LogNormal	0.42	7.4E+03	LogNormal	0.32	7.2E+03	Normal	0.26						
Embodied Energy (MJ)	3.8E+03	LogNormal	0.42	1.3E+05	LogNormal	0.32	1.2E+05	Normal	0.26						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			NO								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							

Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.	
Date Created:	Not Given	Root Cost Multiplier: 1
Approved (YES / NO)?	By User	Date Generated: 02/26/19
Official (YES / NO) ?	By User	
Author:	Not Given	
Revisions:	None	

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.033j

Distribution Panel - Capacity: 1200 to 2000 Amp - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragility or Costing is per unit and is based upon 1600 Amp.

Line633

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

AP 1600

Peak Floor Acceleration

2

DS1

DS2

Mutually Exclusive

Mutually Exclusive

MutEx(DS1.DS2)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none	none			
0.70	0.30			

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

NO

NO

Data Quality

Superior

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions
Repair Description

Repair anchorage and concrete pad (if floor mounted and wall if wall mounted) and remount equipment.

Replace equipment in addition to repairing anchorage and concrete pad if floor mounted or wall if wall mounted.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	9.00E+02	1.20E+03	2.00E+03	4.38E+04	5.26E+04	6.95E+04									
Best fit mean:	1.28E+03			5.43E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00			5.00											
Average Repair Cost (Min Qty, Max Qty)	1.56E+03			6.84E+04											
CV or beta (Min Qty, Max Qty)	0.34			0.19											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.06E+00	1.41E+00	2.35E+00	3.61E+00	4.33E+00	5.72E+00									
Best fit mean:	1.41E+00			4.33E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00			5.00											
Average Repair Time (Min Qty, Max Qty)	1.84E+00			2.29E+01											
CV or beta (Min Qty, Max Qty)	0.42			0.31											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.3E+02	LogNormal	0.42	1.2E+04	LogNormal	0.31									
Embodied Energy (MJ)	3.8E+03	LogNormal	0.42	2.2E+05	LogNormal	0.31									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%			0%											
Loss of Life (Median, Dispersion)	0%			0%											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%			0%											

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.033k

Distribution Panel - Capacity: 1200 to 2000 Amp - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragility o
Costing is per unit and is based upon 1600 Amp.

Line 634

Construction Quality: Normal - Designed for seismic loads but no special seismic certification

Seismic Installation Conditions: Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Fragility Unit of Measure:

AP 1600

Demand Parameter (unit):

Peak Floor Acceleration

g

Number of Damage States:

1

Damage State:

DS1

Type of Damage State:

Sequential

DS Hierarchy

Seq(DS1)

Descriptions

Damaged, inoperative but anchorage is OK.

Illustrations



Damage State Probability:

1.00

Fragility Parameters

Median Demand, θ :

3.05

Data dispersion, β_d :

0.4

Uncertainty, β_u :

0.1

Total Dispersion, β :

0.4

Correlation (Yes / No)

NO

Data Quality

Superior

Documentation Quality

Superior

Directionality (Yes / No)

NO

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Replace equipment

Long Lead Time (Yes / No) YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	4.29E+04	5.14E+04	5.14E+04												
Best fit mean:	4.86E+04														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Cost (Min Qty, Max Qty)	6.17E+04		4.11E+04												
CV or beta (Min Qty, Max Qty)	0.07		0.07												
Quantity Unit:	Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	3.97E+00	4.76E+00	4.76E+00												
Best fit mean:	4.76E+00														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Time (Min Qty, Max Qty)	1.84E+01		2.38E+00												
CV or beta (Min Qty, Max Qty)	0.26		0.26												
Quantity Unit:	Each														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.2E+04	Normal	0.26												
Embodied Energy (MJ)	2.1E+05	Normal	0.26												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.		
Date Created:	Not Given	Root Cost Multiplier:	1
Approved (YES / NO)?	By User	Date Generated:	02/26/19
Official (YES / NO) ?	By User		
Author:	Not Given		
Revisions:	None		

FEMA P-58 Fragility Specification

NISTIR Classification D5092.011a

NISTIR Name Battery Rack - Capacity: all - Unanchored equipment that is not vibration isolated - Equipment fragility only

Description Costing is per unit.

Line 636

Construction Quality:	Normal - Not designed for seismic loads				
Seismic Installation Conditions:	Unanchored equipment that is not vibration isolated				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Simultaneous	Simultaneous	Simultaneous		
DS Hierarchy	Simul(DS1,DS2,DS3)				
Descriptions	Damaged, inoperative. Batteries fall, crack cases, dislodge conductors, or are otherwise damaged. Batteries spill battery acid. Battery rack collapses.				

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		BLDG
Demand Location (floor above?)		No

Illustrations					

Long Lead Time (Yes / No) YES YES YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.10E+04	1.20E+04	1.40E+04	4.00E+02	7.50E+02	9.00E+02	2.20E+03	3.15E+03	4.15E+03						
Best fit mean:	1.23E+04			6.83E+02			3.17E+03								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	1.00			1.00			1.00			5.00					
Average Repair Cost (Min Qty, Max Qty)	1.44E+04			9.00E+02			3.78E+03			2.52E+03					
CV or beta (Min Qty, Max Qty)	0.10			0.29			0.24			0.24					
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.46E+01	1.59E+01	1.85E+01	5.29E-01	9.93E-01	1.19E+00	2.91E+00	4.17E+00	5.49E+00						
Best fit mean:	1.59E+01			9.93E-01			4.17E+00								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	1.00			1.00			1.00			5.00					
Average Repair Time (Min Qty, Max Qty)	1.91E+01			1.19E+00			5.00E+00			3.34E+00					
CV or beta (Min Qty, Max Qty)	0.27			0.38			0.35			0.35					
Quantity Unit:	Each			Each			Each								
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.7E+03	LogNormal	0.27	6.3E+01	Normal	0.38	1.3E+03	Normal	0.35						
Embodied Energy (MJ)	3.2E+04	LogNormal	0.27	1.6E+03	Normal	0.38	2.9E+04	Normal	0.35						
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%			0%			0%			0%					
Loss of Life (Median, Dispersion)	0%			0%			0%			0%					
Post-event Tagging Flag:	NO			NO			NO								
Unsafe Placard Trigger (Median, Dispersion)	0%			0%			0%			0%					

Comments: None

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Not Given

Revisions: None

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5092.013a

Battery Rack - Capacity: all - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragility only

Costing is per unit.

Line637

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

EA 1

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

Mutually Exclusive

MutEx(DS1.DS2)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

none

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

0.70

0.30

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

NO

NO

Data Quality

Superior

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Long Lead Time (Yes / No)

YES

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

8.00E+02

1.00E+03

1.15E+03

P₁₀

P₅₀

P₉₀

1.40E+04

1.62E+04

1.93E+04

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

9.83E+02

Normal

5.00

1.00

1.20E+03

8.00E+02

0.14

Each

1.32E+00

Normal

5.00

1.00

1.59E+00

1.06E+00

0.29

Each

1.6E+02

Normal

0.29

4.9E+03

Normal

0.29

NO

Not Applicable

0%

0.00

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

Not Applicable

0%

0.00

1.40E+04

1.63E+04

LogNormal

1.00

1.94E+04

0.13

Each

2.14E+01

LogNormal

5.00

2.57E+01

1.71E+01

0.28

Each

3.2E+03

LogNormal

0.28

6.6E+04

LogNormal

0.28

NO

Not Applicable

0%

0.00

0%

0.00

NO

Not Applicable

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

Root Cost Multiplier: 1
Date Generated: 02/26/19

Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.	
Date Created:	Not Given	Root Cost Multiplier: 1
Approved (YES / NO)?	By User	Date Generated: 02/26/19
Official (YES / NO) ?	By User	
Author:	Not Given	
Revisions:	None	

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5092.021a

Battery Charger - Capacity: all - Unanchored equipment that is not vibration isolated - Equipment fragility only

Costing is per unit.

Line 640

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Unanchored equipment that is not vibration isolated

EA 1

Peak Floor Acceleration

2

DS1

DS2

Mutually Exclusive

Mutually Exclusive

MutEx(DS1.DS2)

Damaged, inoperative but anchorage is OK.

Damaged, inoperative but anchorage is OK. Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

0.50

none

0.50

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Data Quality

Superior

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Service for intermittent voltage output or for blown surge suppressor.

Replace equipment.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

6.00E+02

8.00E+02

9.00E+02

P₁₀

P₅₀

P₉₀

1.02E+04

1.22E+04

1.42E+04

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

7.67E+02

Normal

1.00

5.00

9.60E+02

6.40E+02

0.15

0.15

Each

Each

P₁₀

P₅₀

P₉₀

7.94E-01

1.06E+00

1.19E+00

P₁₀

P₅₀

P₉₀

1.35E+01

1.61E+01

1.87E+01

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.06E+00

Normal

1.00

5.00

1.27E+00

8.47E-01

0.29

0.29

Each

Each

Median Cost

Best Fit

CV or Beta

2.0E+02

Normal

0.29

Median Cost

Best Fit

CV or Beta

2.6E+03

Normal

0.28

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

3.9E+03

Normal

0.29

4.9E+04

Normal

0.28

NO

Not Applicable

NO

Not Applicable

0%

0.00

0%

0.00

NO

NO

0%

0.00

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5092.023a

Battery Charger - Capacity: all - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragility only

Costing is per unit.

Line 641

Construction Quality:Normal - Designed for seismic loads but no special seismic certification

Seismic Installation Conditions:Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

Fragility Unit of Measure:EA 1

Demand Parameter (unit):Peak Floor Accelerationg

Number of Damage States:2

Damage State:DS1

DS2

Type of Damage State:Mutually Exclusive

DS Hierarchy:MutEx(DS1.DS2)

Descriptions:Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Quantity RoundingRound Qty?YES

Allow sum by floor or building?BLDG

Demand Location (floor above?)No

Illustrations

none

none

Damage State Probability:

0.70

0.30

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

Correlation (Yes / No)

NO

Data Quality

Superior

Documentation Quality

Superior

Directionality (Yes / No)

NO

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad (if floor mounted and wall if wall mounted) and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad / wall.

Long Lead Time (Yes / No)NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	5.00E+02	7.00E+02	8.50E+02	1.07E+04	1.29E+04	1.50E+04									
Best fit mean:	6.83E+02			1.29E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	1.00			1.00											
Average Repair Cost (Min Qty, Max Qty)	7.70E+02			1.41E+04											
CV or beta (Min Qty, Max Qty)	0.20			0.13											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	6.62E-01	9.27E-01	1.13E+00	1.42E+01	1.70E+01	1.99E+01									
Best fit mean:	9.27E-01			1.70E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	1.00			1.00											
Average Repair Time (Min Qty, Max Qty)	1.02E+00			1.87E+01											
CV or beta (Min Qty, Max Qty)	0.32			0.28											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.0E+02	Normal	0.32	2.7E+03	Normal	0.28									
Embodied Energy (MJ)	3.1E+03	Normal	0.32	5.2E+04	Normal	0.28									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

1

02/26/19

Comments:	None	
Date Created:	Not Given	Root Cost Multiplier: 1
Approved (YES / NO)?	By User	Date Generated: 02/26/19
Official (YES / NO) ?	By User	
Author:	Not Given	
Revisions:	None	

FEMA P-58 Fragility Specification

NISTIR Classification	D5092.023c	Line 643
NISTIR Name	Battery Charger - Capacity: all - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage/isolator & equip	
Description	Costing is per unit.	

Construction Quality:	Normal - Designed for seismic loads but no special seismic certification			
Seismic Installation Conditions:	Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Peak Floor Acceleration g			
Number of Damage States:	4			
Damage State:	DS1	DS2	DS3	DS4
Type of Damage State:	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive
DS Hierarchy	MutEx(DS1.DS2,DS3,DS4)			
Descriptions	Anchorage failure.	Anchorage failure & Equipment damaged beyond repair.	Equipment is damaged and inoperative.	Equipment is damaged and inoperative.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?	BLDG	
Demand Location (floor above?)	No	

Illustrations

none	none	none	none	
0.35	0.15	0.25	0.25	

Damage State Probability:					
Fragility Parameters					
Median Demand, θ:	By User	By User	By User	By User	
Data dispersion, β_d:	User to Calculate	User to Calculate	User to Calculate	User to Calculate	
Uncertainty, β_u:	User to Calculate	User to Calculate	User to Calculate	User to Calculate	
Total Dispersion, β:	By User	By User	By User	By User	
Correlation (Yes / No)	NO	Data Quality Superior		Documentation Quality Superior	
Directionality (Yes / No)	NO	Data Relevance Average		Rationality Superior	

Consequence Functions

Repair Description	Repair anchorage and concrete pad (if floor mounted and wall if wall mounted) and remount equipment.	Replace equipment including attached utilities in addition to repairing anchorage and concrete pad / wall.	Service for intermittent voltage output or for blown surge suppressor.	Replace equipment.
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Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Cost by Damage State:	5.00E+02	7.00E+02	8.50E+02	1.07E+04	1.29E+04	1.50E+04	1.02E+04	1.22E+04	1.42E+04	1.02E+04	1.22E+04	1.42E+04			
Best fit mean:	6.83E+02			1.29E+04			1.22E+04			1.22E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00	1.00		5.00			
Average Repair Cost (Min Qty, Max Qty)	9.10E+02		6.30E+02	1.67E+04		1.16E+04	1.58E+04		1.09E+04	1.58E+04		1.09E+04			
CV or beta (Min Qty, Max Qty)	0.20		0.20	0.13		0.13	0.13		0.13	0.13		0.13			
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Time by Damage State:	5.88E-01	8.24E-01	1.00E+00	1.26E+01	1.51E+01	1.76E+01	1.20E+01	1.43E+01	1.66E+01	1.20E+01	1.43E+01	1.66E+01			
Best fit mean:	8.24E-01			1.51E+01			1.43E+01			1.43E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00	1.00		5.00			
Average Repair Time (Min Qty, Max Qty)	1.07E+00		7.41E-01	1.97E+01		1.36E+01	1.86E+01		1.29E+01	1.86E+01		1.29E+01			
CV or beta (Min Qty, Max Qty)	0.32		0.32	0.28		0.28	0.28		0.28	0.28		0.28			
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.0E+02	Normal	0.32	2.7E+03	Normal	0.28	2.6E+03	Normal	0.28	2.6E+03	Normal	0.28			
Embodied Energy (MJ)	3.1E+03	Normal	0.32	5.2E+04	Normal	0.28	4.9E+04	Normal	0.28	4.9E+04	Normal	0.28			
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00				
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00				
Post-event Tagging Flag:	NO			NO			NO			NO					
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00				

Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.	
Date Created:	Not Given	Root Cost Multiplier: 1
Approved (YES / NO)?	By User	Date Generated: 02/26/19
Official (YES / NO) ?	By User	
Author:	Not Given	
Revisions:	None	

FEMA P-58 Fragility Specification

NISTIR Classification		D5092.031a				Line 644
NISTIR Name		Diesel generator - Capacity: 100 to <350 kVA - Unanchored equipment that is not vibration isolated - Equipment fragility only				
Description		Costing is per unit and is based upon 250 kVA.				
Construction Quality:		Normal - Not designed for seismic loads				
Seismic Installation Conditions:		Unanchored equipment that is not vibration isolated				
Fragility Unit of Measure:		KV 250			Quantity Rounding: Round Qty? YES Allow sum by floor or building? BLDG Demand Location (floor above?) No	
Demand Parameter (unit):		Peak Floor Acceleration g				
Number of Damage States:		4				
Damage State:		DS1	DS2	DS3	DS4	
Type of Damage State:		Mutually Exclusive		Mutually Exclusive	Mutually Exclusive	
DS Hierarchy		MutEx(DS1,DS2,DS3,DS4)				
Descriptions		Damaged, inoperative. Pipes and nozzles damaged.		Damaged, inoperative. Drive shaft misalignment.		Damaged, inoperative. Minor electrical damage, e.g., failed relay.
						Damaged, inoperative. Exhaust line disconnected at expansion bellows.
Illustrations						
						
D5092.031b-DS1-1.JPG		none		none		none
Damage State Probability:		0.70		0.10		0.10
Fragility Parameters						
Median Demand, θ :		0.9		0.9		0.9
Data dispersion, β_d :		0.4		0.60		0.6
Uncertainty, β_u :		0.1		0.1		0.1
Total Dispersion, β :		0.4		0.4		0.4
Correlation (Yes / No)		NO		Data Quality Average		Documentation Quality Superior
Directionality (Yes / No)		NO		Data Relevance Average		Rationality Superior
Consequence Functions						
Repair Description		Repair fracture pipes and damaged nozzles. Overhaul because of drive shaft misalignment. Minor electrical repair e.g., replace relay. Reconnect exhaust line.				
Long Lead Time (Yes / No)						
		NO		NO		NO
Repair Costs:						
Repair Cost by Damage State:		P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀
Best fit mean:		1.70E+02 2.00E+02 2.60E+02	2.13E+03 2.50E+03 3.25E+03	4.30E+02 5.00E+02 6.50E+02	4.30E+02 5.00E+02 6.50E+02	
Best Fit Distribution:		2.07E+02 LogNormal	2.58E+03 LogNormal	5.19E+02 LogNormal	5.19E+02 LogNormal	
Quantity Plateau (Min Qty, Max Qty)		1.00 5.00	1.00 5.00	1.00 5.00	1.00 5.00	
Average Repair Cost (Min Qty, Max Qty)		2.20E+02 1.80E+02	3.25E+03 2.00E+03	6.00E+02 4.00E+02	6.00E+02 4.00E+02	
CV or beta (Min Qty, Max Qty)		0.17 0.17	0.17 0.17	0.17 0.17	0.17 0.17	
Quantity Unit:		Each	Each	Each	Each	
Repair Time:		P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀
Repair Time by Damage State:		1.50E-01 1.77E-01 2.29E-01	1.88E+00 2.21E+00 2.87E+00	3.79E-01 4.41E-01 5.74E-01	3.79E-01 4.41E-01 5.74E-01	
Best fit mean:		1.77E-01	2.21E+00	4.41E-01	4.41E-01	
Best Fit Distribution:		LogNormal	LogNormal	LogNormal	LogNormal	
Quantity Plateau (Min Qty, Max Qty)		1.00 5.00	1.00 5.00	1.00 5.00	1.00 5.00	
Average Repair Time (Min Qty, Max Qty)		1.94E-01 1.59E-01	2.87E+00 1.76E+00	5.29E-01 3.53E-01	5.29E-01 3.53E-01	
CV or beta (Min Qty, Max Qty)		0.30 0.30	0.30 0.30	0.30 0.30	0.30 0.30	
Quantity Unit:		Each	Each	Each	Each	
Environmental Impacts:		Median Cost Best Fit CV or Beta	Median Cost Best Fit CV or Beta	Median Cost Best Fit CV or Beta	Median Cost Best Fit CV or Beta	Median Cost Best Fit CV or Beta
Embodied Carbon (kg CO2eq)		8.3E+00 LogNormal 0.30	1.0E+02 LogNormal 0.30	2.1E+01 LogNormal 0.30	2.1E+01 LogNormal 0.30	
Embodied Energy (MJ)		1.8E+02 LogNormal 0.30	2.3E+03 LogNormal 0.30	4.6E+02 LogNormal 0.30	4.6E+02 LogNormal 0.30	
LifeSafety Hazard:						
Potential non-collapse casualties? (Yes / No)		NO		NO		
Casualty-affected Planar Area (sf) per Normative Unit:		Not Applicable		Not Applicable		
Serious Injury (Median, Dispersion)		0% 0.00		0% 0.00		
Loss of Life (Median, Dispersion)		0% 0.00		0% 0.00		
Post-event Tagging Flag:		NO		NO		
Unsafe Placard Trigger (Median, Dispersion)		0% 0.00		0% 0.00		
Comments:		None				
Date Created:		Not Given				
Approved (YES / NO)?		By User				
Official (YES / NO) ?		By User				
Author:		Not Given				
Revisions:		2011-08-24 DS2, DS3, DS4 median changed from 0.3 to 0.9 and beta changed from 0.6 to 0.4 in order to match D5092.031b,c,d.				
Root Cost Multiplier:		1				
Date Generated:		02/26/19				

Root Cost Multiplier: 1
Date Generated: 02/26/19

Root Cost Multiplier: 1
Date Generated: 02/26/19

Comments:	None		
Date Created:	Not Given		
Approved (YES / NO)?	By User	Root Cost Multiplier:	1
Official (YES / NO) ?	By User	Date Generated:	02/26/19
Author:	Not Given		
Revisions:	None		

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5092.032a

Diesel generator - Capacity: 100 to <350 kVA - Vibration isolated equipment that is not snubbed or restrained - Anchorage fragility only

Costing is per unit and is based upon 250 kVA.

Line 648

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

KV 250

Peak Floor Acceleration

2

DS1

Mutually Exclusive

MutEx(DS1.DS2)

Anchorage failure.

DS2

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D5092.031a-DS1-1.JPG

none

Damage State Probability:

0.70

0.30

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

By User

User to Calculate

User to Calculate

By User

NO

NO

By User

User to Calculate

User to Calculate

By User

Data Quality Average

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

5.00E+02

1.00E+03

1.70E+03

8.66E+04

1.02E+05

1.34E+05

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

4.41E-01

8.82E-01

1.50E+00

1.53E+01

1.80E+01

2.36E+01

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

1.1E+02

LogNormal

0.52

2.4E+04

LogNormal

0.30

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5092.032b

Diesel generator - Capacity: 100 to <350 kVA - Vibration isolated equipment that is not snubbed or restrained - Equipment fragility only

Costing is per unit and is based upon 250 kVA.

Line 649

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

KV 250

Peak Floor Acceleration

4

DS1

Mutually Exclusive

MutEx(DS1,DS2,DS3,DS4)

Damaged, inoperative but anchorage is OK. Pipes and nozzles damaged.

DS2

Mutually Exclusive

Damaged, inoperative but anchorage is OK. Drive shaft misalignment.

DS3

Mutually Exclusive

Damaged, inoperative but anchorage is OK. Minor electrical damage, e.g., failed relay.

DS4

Mutually Exclusive

Damaged, inoperative but anchorage is OK. Exhaust line disconnected at expansion bellows.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D5092.031b-DS1-1.JPG

none

none

none

0.70

0.10

0.10

0.10

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

1.07

0.4

0.1

0.4

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair fracture pipes and damaged nozzles.

Overhaul because of drive shaft misalignment.

Minor electrical repair e.g., replace relay.

Reconnect exhaust line.

Long Lead Time (Yes / No)

NO

NO

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.70E+02

2.00E+02

2.60E+02

2.13E+03

2.50E+03

3.25E+03

4.30E+02

5.00E+02

6.50E+02

4.30E+02

5.00E+02

6.50E+02

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.50E-01

1.77E-01

2.29E-01

1.88E+00

2.21E+00

2.87E+00

3.79E-01

4.41E-01

5.74E-01

3.79E-01

4.41E-01

5.74E-01

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

8.3E+00

LogNormal

0.30

1.0E+02

LogNormal

0.30

2.1E+01

LogNormal

0.30

2.1E+01

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

2.3E+03

LogNormal

0.30

4.6E+02

LogNormal

0.30

4.6E+02

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5092.032c

Diesel generator - Capacity: 100 to <350 kVA - Vibration isolated equipment that is not snubbed or restrained - Combined anchorage/isolator & equipment fragility

Costing is per unit and is based upon 250 kVA.

Line 650

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

KV 250

Peak Floor Acceleration

g

5

DS1

Mutually Exclusive

MutEx(DS1,DS2,DS3,DS4,DS5)

Anchorage failure.

DS2

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

DS3

Mutually Exclusive

Damaged, inoperative but anchorage is OK

DS4

Mutually Exclusive

Equipment is damaged and inoperative but anchorage is OK.

DS5

Mutually Exclusive

Equipment is damaged and inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D5092.031a-DS1-1.JPG

none

none

none

none

Damage State Probability:

0.35

0.15

0.40

0.05

0.05

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

User to Calculate

By User

NO

Data Quality

Average

Documentation Quality

Superior

NO

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Repair fracture pipes & damaged nozzles, and or reconnect exhaust line.

Overhaul because of drive shaft misalignment. minor electrical repair e.g., replace relays.

Long Lead Time (Yes / No)

NO

NO

NO

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

5.00E+02

1.00E+03

1.70E+03

P₁₀

P₅₀

P₉₀

8.66E+04

1.02E+05

1.34E+05

P₁₀

P₅₀

P₉₀

1.70E+02

2.00E+02

2.60E+02

P₁₀

P₅₀

P₉₀

2.13E+03

2.50E+03

3.25E+03

P₁₀

P₅₀

P₉₀

4.30E+02

5.00E+02

6.50E+02

9.59E+02

LogNormal

1.00

5.00

1.06E+05

LogNormal

1.00

5.00

2.07E+02

LogNormal

1.00

5.00

2.58E+03

LogNormal

1.00

5.00

5.19E+02

LogNormal

1.00

5.00

1.30E+03

9.00E+02

1.33E+05

9.20E+04

2.60E+02

1.80E+02

3.25E+03

2.25E+03

6.50E+02

4.50E+02

0.45

0.45

0.17

0.17

0.17

0.17

0.17

0.17

0.17

0.17

Each

Each

Each

Each

Each

Each

Each

Each

P₁₀

P₅₀

P₉₀

5.15E-01

1.03E+00

1.75E+00

P₁₀

P₅₀

P₉₀

1.78E+01

2.10E+01

2.75E+01

P₁₀

P₅₀

P₉₀

1.75E-01

2.06E-01

2.68E-01

P₁₀

P₅₀

P₉₀

2.19E+00

2.57E+00

3.35E+00

P₁₀

P₅₀

P₉₀

4.43E-01

5.15E-01

6.69E-01

1.03E+00

LogNormal

1.00

5.00

2.10E+01

LogNormal

1.00

5.00

2.06E-01

LogNormal

1.00

5.00

2.57E+00

LogNormal

1.00

5.00

5.15E-01

LogNormal

1.00

5.00

1.34E+00

9.26E-01

5.26E+01

1.05E+01

2.68E-01

1.85E-01

3.35E+00

2.32E+00

6.69E-01

4.63E-01

0.52

0.52

0.30

0.30

0.30

0.30

0.30

0.30

0.30

0.30

Each

Each

Each

Each

Each

Each

Each

Each

Median Cost

Best Fit

CV or Beta

1.1E+02

LogNormal

0.52

Median Cost

Best Fit

CV or Beta

2.4E+04

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

8.3E+00

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

1.0E+02

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

1.4E+01

LogNormal

0.30

2.1E+02

LogNormal

0.52

4.6E+05

LogNormal

0.30

1.8E+02

LogNormal

0.30

2.3E+03

LogNormal

0.30

2.7E+02

LogNormal

0.30

NO

NO

NO

NO

NO

Not Applicable

Not Applicable

Not Applicable

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

0%

0.00

0%

0.00

NO

NO

NO

NO

NO

0%

0.00

0%

0.00

0%

0.00

0%

0.00

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5092.032d

Diesel generator - Capacity: 350 to <750 kVA - Vibration isolated equipment that is not snubbed or restrained - Anchorage fragility only

Costing is per unit and is based upon 500 kVA.

Line 65.1

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

KV 500

Peak Floor Acceleration

2

DS1

Mutually Exclusive

MutEx(DS1.DS2)

Anchorage failure.

DS2

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D5092.031a-DS1-1.JPG

none

Damage State Probability:

0.70

0.30

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

By User

User to Calculate

User to Calculate

By User

NO

NO

By User

User to Calculate

User to Calculate

By User

Data Quality Average

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Consequence Functions

Repair Description

Repair anchorages and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Long Lead Time (Yes / No)

YES

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

8.00E+02

1.50E+03

2.40E+03

Normal

1.00

5.00

1.65E+03

0.40

Each

P₁₀

P₅₀

P₉₀

1.73E+05

2.05E+05

2.67E+05

LogNormal

1.00

5.00

2.66E+05

0.17

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

7.06E-01

1.32E+00

2.12E+00

Normal

1.00

5.00

1.46E+00

0.47

Each

P₁₀

P₅₀

P₉₀

2.29E+01

2.71E+01

3.53E+01

LogNormal

1.00

5.00

8.12E+01

0.30

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

1.7E+02

Normal

0.47

4.9E+04

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

5.0E+03

Normal

0.47

9.3E+05

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5092.032f

Diesel generator - Capacity: 350 to <750 kVA - Vibration isolated equipment that is not snubbed or restrained - Combined anchorage/isolator & equipment fragility

Costing is per unit and is based upon 500 kVA.

Line 653

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

KV 500

Peak Floor Acceleration

g

5

DS1

Mutually Exclusive

MutEx(DS1.DS2.DS3.DS4.DS5)

Anchorage failure.

DS2

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

DS3

Mutually Exclusive

Damaged, inoperative but anchorage is OK

DS4

Mutually Exclusive

Equipment is damaged and inoperative but anchorage is OK.

DS5

Mutually Exclusive

Equipment is damaged and inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D5092.031a-DS1-1.JPG

none

none

none

none

Damage State Probability:

0.35

0.15

0.40

0.05

0.05

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

User to Calculate

By User

NO

Data Quality

Average

Documentation Quality

Superior

NO

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Repair fracture pipes & damaged nozzles, and or reconnect exhaust line.

Overhaul because of drive shaft misalignment. minor electrical repair e.g., replace relays.

Long Lead Time (Yes / No)

YES

YES

YES

YES

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

8.00E+02

1.50E+03

2.40E+03

P₁₀

P₅₀

P₉₀

1.73E+05

2.05E+05

2.67E+05

P₁₀

P₅₀

P₉₀

3.40E+02

4.00E+02

5.20E+02

P₁₀

P₅₀

P₉₀

4.25E+03

5.00E+03

6.50E+03

P₁₀

P₅₀

P₉₀

6.80E+02

8.00E+02

1.04E+03

1.57E+03

Normal

1.00

5.00

2.11E+05

LogNormal

1.00

5.00

4.13E+02

LogNormal

1.00

5.00

5.17E+03

LogNormal

1.00

5.00

8.26E+02

LogNormal

1.00

5.00

1.95E+03

1.35E+03

2.66E+05

1.84E+05

5.20E+02

3.60E+02

6.50E+03

4.50E+03

1.04E+03

7.20E+02

0.40

0.40

0.17

0.17

0.17

0.17

0.17

0.17

0.17

0.17

Each

Each

Each

Each

Each

P₁₀

P₅₀

P₉₀

8.24E-01

1.54E+00

2.47E+00

P₁₀

P₅₀

P₉₀

2.68E+01

3.16E+01

4.12E+01

P₁₀

P₅₀

P₉₀

3.50E-01

4.12E-01

5.35E-01

P₁₀

P₅₀

P₉₀

4.38E+00

5.15E+00

6.69E+00

P₁₀

P₅₀

P₉₀

7.00E-01

8.24E-01

1.07E+00

1.54E+00

Normal

1.00

5.00

3.16E+01

LogNormal

1.00

5.00

4.12E-01

LogNormal

1.00

5.00

5.15E+00

LogNormal

1.00

5.00

8.24E-01

LogNormal

1.00

5.00

2.01E+00

1.39E+00

9.47E+01

1.58E+01

5.35E-01

3.71E-01

6.69E+00

4.63E+00

1.07E+00

7.41E-01

0.47

0.47

0.30

0.30

0.30

0.30

0.30

0.30

0.30

0.30

Each

Each

Each

Each

Each

Median Cost

Best Fit

CV or Beta

1.7E+02

Normal

0.47

Median Cost

Best Fit

CV or Beta

4.9E+04

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

1.7E+01

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

2.1E+02

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

2.3E+01

LogNormal

0.30

5.0E+03

Normal

0.47

9.3E+05

LogNormal

0.30

3.7E+02

LogNormal

0.30

4.6E+03

LogNormal

0.30

4.3E+02

LogNormal

0.30

NO

Not Applicable

NO

Not Applicable

NO

Not Applicable

NO

Not Applicable

NO

Not Applicable

0%

0.00

0%

0.00

0%

0.00

0%

0.00

0%

0.00

0%

0.00

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0%

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0.00

0%

0.00

NO

NO

NO

NO

NO

NO

NO

NO

NO

NO

0%

0.00

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0.00

0%

0.00

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.		
Date Created:	Not Given	Root Cost Multiplier:	1
Approved (YES / NO)?	By User	Date Generated:	02/26/19
Official (YES / NO) ?	By User		
Author:	Not Given		
Revisions:	None		

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5092.032j

Diesel generator - Capacity: 1200 to 2000 kVa - Vibration isolated equipment that is not snubbed or restrained - Anchorage fragility only

Costing is per unit and is based upon 1500 kVa.

Line 657

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

KV 1500

Peak Floor Acceleration

2

DS1

Mutually Exclusive

MutEx(DS1.DS2)

Anchorage failure.

DS2

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D5092.031a-DS1-1.JPG

none

0.70

0.30

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

By User

User to Calculate

User to Calculate

By User

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Long Lead Time (Yes / No)

YES

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.60E+03

2.40E+03

3.40E+03

2.36E+03

LogNormal

1.00

5.00

2.64E+03

2.16E+03

0.29

0.29

Each

P₁₀

P₅₀

P₉₀

4.84E+05

5.71E+05

7.43E+05

5.90E+05

LogNormal

1.00

5.00

7.42E+05

4.57E+05

0.17

0.17

Each

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.41E+00

2.12E+00

3.00E+00

2.12E+00

LogNormal

1.00

5.00

2.33E+00

1.91E+00

0.38

0.38

Each

P₁₀

P₅₀

P₉₀

2.99E+01

3.53E+01

4.59E+01

3.53E+01

LogNormal

1.00

5.00

1.86E+02

1.76E+01

0.30

0.30

Each

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

2.5E+02

LogNormal

0.38

7.4E+03

LogNormal

0.38

Median Cost

Best Fit

CV or Beta

1.4E+05

LogNormal

0.30

2.6E+06

LogNormal

0.30

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5092.033a

Diesel generator - Capacity: 100 to <350 kVA - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragility only

Costing is per unit and is based upon 250 kVA.

Line 660

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

KV 250

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

Mutually Exclusive

MutEx(DS1.DS2)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations



Damage State Probability:

0.70

0.30

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	5.00E+02	1.00E+03	1.70E+03	8.66E+04	1.02E+05	1.34E+05									
Best fit mean:	9.59E+02			1.06E+05											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00			1.00											
Average Repair Cost (Min Qty, Max Qty)	1.30E+03			1.33E+05											
CV or beta (Min Qty, Max Qty)	0.45			0.17											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.15E-01	1.03E+00	1.75E+00	1.78E+01	2.10E+01	2.75E+01									
Best fit mean:	1.03E+00			2.10E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00			1.00											
Average Repair Time (Min Qty, Max Qty)	1.34E+00			5.26E+01											
CV or beta (Min Qty, Max Qty)	0.52			0.30											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.1E+02	LogNormal	0.52	2.4E+04	LogNormal	0.30									
Embodied Energy (MJ)	3.2E+03	LogNormal	0.52	4.6E+05	LogNormal	0.30									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%			0%											
Loss of Life (Median, Dispersion)	0%			0%											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%			0%											

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

D5092.033b

Line 661

NISTIR Name
Description

Diesel generator - Capacity: 100 to <350 kVA - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragility only
Costing is per unit and is based upon 250 kVA.

Construction Quality:

Normal - Designed for seismic loads but no special seismic certification

Seismic Installation Conditions:

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

Fragility Unit of Measure:

KV 250

Demand Parameter (unit):

Peak Floor Acceleration g

Quantity Rounding

Round Qty? YES

Allow sum by floor or building? BLDG

Demand Location (floor above?) No

Number of Damage States:

4

Damage State:

DS1

DS2

DS3

DS4

Type of Damage State:

Mutually Exclusive

Mutually Exclusive

Mutually Exclusive

Mutually Exclusive

DS Hierarchy

MutEx(DS1,DS2,DS3,DS4)

Descriptions

Damaged, inoperative but anchorage is OK. Pipes and nozzles damaged.

Damaged, inoperative but anchorage is OK. Drive shaft misalignment.

Damaged, inoperative but anchorage is OK. Minor electrical damage, e.g., failed relay.

Damaged, inoperative but anchorage is OK. Exhaust line disconnected at expansion bellows.

Illustrations



D5092.031b-DS1-1.JPG

none

none

none

Damage State Probability:

0.70

0.10

0.10

0.10

Fragility Parameters

Median Demand, θ :

2

2

2

2

Data dispersion, β_d :

0.2

0.20

0.2

0.2

Uncertainty, β_u :

0.1

0.1

0.1

0.1

Total Dispersion, β :

0.2

0.2

0.2

0.2

Correlation (Yes / No)

NO

Directionality (Yes / No)

NO

Data Quality Average

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Consequence Functions

Repair Description

Repair fracture pipes and damaged nozzles.

Overhaul because of drive shaft misalignment.

Minor electrical repair e.g., replace relay.

Reconnect exhaust line.

Long Lead Time (Yes / No)

NO

NO

NO

NO

Repair Costs:

Repair Cost by Damage State:

1.70E+02

2.00E+02

2.60E+02

2.13E+03

2.50E+03

3.25E+03

4.30E+02

5.00E+02

6.50E+02

4.30E+02

5.00E+02

6.50E+02

4.30E+02

5.00E+02

6.50E+02

Best fit mean:

2.07E+02

2.58E+03

5.19E+02

5.19E+02

Best Fit Distribution:

LogNormal

LogNormal

LogNormal

LogNormal

Quantity Plateau

1.00

1.00

1.00

1.00

(Min Qty, Max Qty)

1.00

1.00

1.00

1.00

Average Repair Cost

2.60E+02

3.25E+03

6.50E+02

4.50E+02

(Min Qty, Max Qty)

2.60E+02

3.25E+03

6.50E+02

4.50E+02

CV or beta (Min Qty, Max Qty)

0.17

0.17

0.17

0.17

Quantity Unit:

Each

Each

Each

Each

Repair Time:

Repair Time by Damage State:

1.75E-01

2.06E-01

2.68E-01

2.19E+00

2.57E+00

3.35E+00

4.43E-01

5.15E-01

6.69E-01

4.43E-01

5.15E-01

6.69E-01

4.43E-01

5.15E-01

6.69E-01

Best fit mean:

2.06E-01

2.57E+00

5.15E-01

5.15E-01

Best Fit Distribution:

LogNormal

LogNormal

LogNormal

LogNormal

Quantity Plateau

1.00

1.00

1.00

1.00

(Min Qty, Max Qty)

1.00

1.00

1.00

1.00

Average Repair Time (Min Qty, Max Qty)

2.68E-01

3.35E+00

6.69E-01

4.63E-01

(Min Qty, Max Qty)

2.68E-01

3.35E+00

6.69E-01

4.63E-01

CV or beta (Min Qty, Max Qty)

0.30

0.30

0.30

0.30

Quantity Unit:

Each

Each

Each

Each

Environmental Impacts:

Embodied Carbon (kg CO2eq)

8.3E+00

LogNormal

0.30

1.0E+02

LogNormal

0.30

2.1E+01

LogNormal

0.30

2.1E+01

LogNormal

0.30

2.1E+01

LogNormal

0.30

Embodied Energy (MJ)

1.8E+02

LogNormal

0.30

2.3E+03

LogNormal

0.30

4.6E+02

LogNormal

0.30

4.6E+02

LogNormal

0.30

4.6E+02

LogNormal

0.30

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

NO

NO

NO

NO

Casualty-affected Planar Area (sf) per Normative Unit:

Not Applicable

Not Applicable

Not Applicable

Not Applicable

Serious Injury (Median, Dispersion)

0%

0.00

0%

0.00

0%

0.00

0%

0.00

Loss of Life (Median, Dispersion)

0%

0.00

0%

0.00

0%

0.00

0%

0.00

Post-event Tagging Flag:

NO

NO

NO

NO

Unsafe Placard Trigger (Median, Dispersion)

0%

0.00

0%

0.00

0%

0.00

0%

0.00

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

None

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5092.033c

Diesel generator - Capacity: 100 to <350 kVA - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage/isc

Costing is per unit and is based upon 250 kVA.

Line 662

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

KV 250

Peak Floor Acceleration

g

5

DS1

Mutually Exclusive

MutEx(DS1,DS2,DS3,DS4,DS5)

Anchorage failure.

DS2

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

DS3

Mutually Exclusive

Damaged, inoperative but anchorage is OK

DS4

Mutually Exclusive

Equipment is damaged and inoperative but anchorage is OK.

DS5

Mutually Exclusive

Equipment is damaged and inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D5092.031a-DS1-1.JPG

0.35

none

0.15

none

0.40

none

0.05

none

0.05

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

NO

Data Quality

Average

Documentation Quality

Superior

NO

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Repair fracture pipes & damaged nozzles, and or reconnect exhaust line.

Overhaul because of drive shaft misalignment. minor electrical repair e.g., replace relays.

Long Lead Time (Yes / No)

NO

NO

NO

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

5.00E+02

1.00E+03

1.70E+03

P₁₀

P₅₀

P₉₀

8.66E+04

1.02E+05

1.34E+05

P₁₀

P₅₀

P₉₀

1.70E+02

2.00E+02

2.60E+02

P₁₀

P₅₀

P₉₀

2.13E+03

2.50E+03

3.25E+03

P₁₀

P₅₀

P₉₀

4.30E+02

5.00E+02

6.50E+02

9.59E+02

LogNormal

1.00

5.00

1.10E+03

7.00E+02

0.45

0.45

Each

1.06E+05

LogNormal

1.00

5.00

1.12E+05

9.20E+04

0.17

0.17

Each

2.07E+02

LogNormal

1.00

5.00

2.20E+02

1.80E+02

0.17

0.17

Each

2.58E+03

LogNormal

1.00

5.00

2.75E+03

2.25E+03

0.17

0.17

Each

5.19E+02

LogNormal

1.00

5.00

5.50E+02

4.50E+02

0.17

0.17

Each

P₁₀

P₅₀

P₉₀

7.35E-02

1.47E-01

2.50E-01

P₁₀

P₅₀

P₉₀

2.55E+00

3.01E+00

3.93E+00

P₁₀

P₅₀

P₉₀

2.50E-02

2.94E-02

3.82E-02

P₁₀

P₅₀

P₉₀

3.13E-01

3.68E-01

4.78E-01

P₁₀

P₅₀

P₉₀

6.32E-02

7.35E-02

9.56E-02

1.47E-01

LogNormal

1.00

5.00

4.51E+00

1.50E+00

0.30

0.30

Each

2.94E-02

LogNormal

1.00

5.00

3.23E-02

2.65E-02

0.30

0.30

Each

3.68E-01

LogNormal

1.00

5.00

4.04E-01

3.31E-01

0.30

0.30

Each

7.35E-02

LogNormal

1.00

5.00

8.09E-02

6.61E-02

0.30

0.30

Each

Median Cost

Best Fit

CV or Beta

1.1E+02

LogNormal

0.52

2.4E+04

LogNormal

0.30

8.3E+00

LogNormal

0.30

1.0E+02

LogNormal

0.30

1.4E+01

LogNormal

0.30

3.2E+03

LogNormal

0.52

4.6E+05

LogNormal

0.30

1.8E+02

LogNormal

0.30

2.3E+03

LogNormal

0.30

2.7E+02

LogNormal

0.30

NO

NO

NO

NO

NO

Not Applicable

Not Applicable

Not Applicable

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

0%

0.00

0%

0.00

NO

NO

NO

NO

NO

0%

0.00

0%

0.00

0%

0.00

0%

0.00

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5092.033d

Diesel generator - Capacity: 350 to <750 kVA - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragility only

Costing is per unit and is based upon 500 kVA.

Line 663

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

KV 500

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

Mutually Exclusive

MutEx(DS1.DS2)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations



Damage State Probability:

0.70

0.30

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Long Lead Time (Yes / No)

	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Costs:															
Repair Cost by Damage State:	8.00E+02	1.50E+03	2.40E+03	1.73E+05	2.05E+05	2.67E+05									
Best fit mean:		1.57E+03			2.11E+05										
Best Fit Distribution:		Normal			LogNormal										
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Cost (Min Qty, Max Qty)	1.95E+03		1.35E+03	2.66E+05		1.84E+05									
CV or beta (Min Qty, Max Qty)	0.40		0.40	0.17		0.17									
Quantity Unit:		Each			Each										
Repair Time:															
Repair Time by Damage State:	8.24E-01	1.54E+00	2.47E+00	2.68E+01	3.16E+01	4.12E+01									
Best fit mean:		1.54E+00			3.16E+01										
Best Fit Distribution:		Normal			LogNormal										
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Time (Min Qty, Max Qty)	2.01E+00		1.39E+00	9.47E+01		1.58E+01									
CV or beta (Min Qty, Max Qty)	0.47		0.47	0.30		0.30									
Quantity Unit:		Each			Each										
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.7E+02	Normal	0.47	4.9E+04	LogNormal	0.30									
Embodied Energy (MJ)	5.0E+03	Normal	0.47	9.3E+05	LogNormal	0.30									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)		NO			NO										
Casualty-affected Planar Area (sf) per Normative Unit:		Not Applicable			Not Applicable										
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:		NO			NO										
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5092.033e

Diesel generator - Capacity: 350 to <750 kVA - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragility only

Costing is per unit and is based upon 500 kVA.

Line 664

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

KV 500

Peak Floor Acceleration g

4

DS1

Mutually Exclusive

MutEx(DS1.DS2.DS3.DS4)

Damaged, inoperative but anchorage is OK. Pipes and nozzles damaged.

DS2

Mutually Exclusive

Damaged, inoperative but anchorage is OK. Drive shaft misalignment.

DS3

Mutually Exclusive

Damaged, inoperative but anchorage is OK. Minor electrical damage, e.g., failed relay.

DS4

Mutually Exclusive

Damaged, inoperative but anchorage is OK. Exhaust line disconnected at expansion bellows.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D5092.031b-DS1-1.JPG

none

none

none

0.70

0.10

0.10

0.10

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

2

0.2

0.1

0.2

NO

NO

Data Quality Average

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Consequence Functions

Repair Description

Repair fracture pipes and damaged nozzles.

Overhaul because of drive shaft misalignment.

Minor electrical repair e.g., replace relay.

Reconnect exhaust line.

Long Lead Time (Yes / No)

YES

YES

YES

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

P₁₀

P₅₀

P₉₀

3.40E+02

4.00E+02

5.20E+02

P₁₀

P₅₀

P₉₀

4.25E+03

5.00E+03

6.50E+03

P₁₀

P₅₀

P₉₀

6.80E+02

8.00E+02

1.04E+03

P₁₀

P₅₀

P₉₀

6.80E+02

8.00E+02

1.04E+03

P₁₀

P₅₀

P₉₀

4.13E+02

LogNormal

1.00

5.00

5.17E+03

LogNormal

1.00

5.00

8.26E+02

LogNormal

1.00

5.00

8.26E+02

LogNormal

1.00

5.00

5.20E+02

3.20E+02

0.17

0.17

6.50E+03

4.00E+03

0.17

0.17

9.60E+02

6.40E+02

0.17

0.17

9.60E+02

6.40E+02

0.17

0.17

Each

Each

Each

Each

P₁₀

P₅₀

P₉₀

4.50E-01

5.29E-01

6.88E-01

P₁₀

P₅₀

P₉₀

5.63E+00

6.62E+00

8.60E+00

P₁₀

P₅₀

P₉₀

9.00E-01

1.06E+00

1.38E+00

P₁₀

P₅₀

P₉₀

9.00E-01

1.06E+00

1.38E+00

P₁₀

P₅₀

P₉₀

5.29E-01

LogNormal

1.00

5.00

6.62E+00

LogNormal

1.00

5.00

1.06E+00

LogNormal

1.00

5.00

1.06E+00

LogNormal

1.00

5.00

6.88E-01

4.24E-01

0.30

0.30

8.60E+00

5.29E+00

0.30

0.30

1.27E+00

8.47E-01

0.30

0.30

1.27E+00

8.47E-01

0.30

0.30

Each

Each

Each

Each

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

Median Cost

Best Fit

CV or Beta

1.7E+01

LogNormal

0.30

2.1E+02

LogNormal

0.30

2.3E+01

LogNormal

0.30

3.3E+01

LogNormal

0.30

3.7E+02

LogNormal

0.30

4.6E+03

LogNormal

0.30

4.3E+02

LogNormal

0.30

7.3E+02

LogNormal

0.30

NO

Not Applicable

NO

Not Applicable

NO

Not Applicable

NO

Not Applicable

0%

0.00

0%

0.00

0%

0.00

0%

0.00

NO

NO

NO

NO

0%

0.00

0%

0.00

0%

0.00

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name


Description

D5092.033f

Diesel generator - Capacity: 350 to <750 kVA - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage/isc
Costing is per unit and is based upon 500 kVA.

Line 665

Construction Quality:	Normal - Designed for seismic loads but no special seismic certification				
Seismic Installation Conditions:	Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints				
Fragility Unit of Measure:	KV 500				
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	5				
Damage State:	DS1	DS2	DS3	DS4	DS5
Type of Damage State:	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive
DS Hierarchy	MutEx(DS1,DS2,DS3,DS4,DS5)				
Descriptions	Anchorage failure.	Anchorage failure & Equipment damaged beyond repair.	Damaged, inoperative but anchorage is OK	Equipment is damaged and inoperative but anchorage is OK.	Equipment is damaged and inoperative but anchorage is OK.

Illustrations					
<div><div></div><div>DS1</div><div>D5092.031a-DS1-1.JPG</div></div> <div><div></div><div>DS2</div><div>none</div></div> <div><div></div><div>DS3</div><div>none</div></div> <div><div></div><div>DS4</div><div>none</div></div> <div><div></div><div>DS5</div><div>none</div></div>					
Damage State Probability:	0.35	0.15	0.40	0.05	0.05
Fragility Parameters					
Median Demand, θ :	By User	By User	By User	By User	By User
Data dispersion, β_d :	User to Calculate	User to Calculate	User to Calculate	User to Calculate	User to Calculate
Uncertainty, β_u :	User to Calculate	User to Calculate	User to Calculate	User to Calculate	User to Calculate
Total Dispersion, β :	By User	By User	By User	By User	By User
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Superior	
Directionality (Yes / No)	NO	Data Relevance Average		Rationality Superior	
Consequence Functions					
Repair Description	Repair anchorage and concrete pad and remount equipment.	Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.	Repair fracture pipes & damaged nozzles, and or reconnect exhaust line.	Overhaul because of drive shaft misalignment.	minor electrical repair e.g., replace relays.

Long Lead Time (Yes / No)	YES			YES			YES			YES			YES		
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	8.00E+02	1.50E+03	2.40E+03	1.73E+05	2.05E+05	2.67E+05	3.40E+02	4.00E+02	5.20E+02	4.25E+03	5.00E+03	6.50E+03	6.80E+02	8.00E+02	1.04E+03
Best fit mean:	1.57E+03 Normal			2.11E+05 LogNormal			4.13E+02 LogNormal			5.17E+03 LogNormal			8.26E+02 LogNormal		
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00	1.00		5.00	1.00		5.00
Average Repair Cost (Min Qty, Max Qty)	1.65E+03		1.35E+03	2.25E+05		1.84E+05	4.40E+02		3.60E+02	5.50E+03		4.50E+03	8.80E+02		7.20E+02
CV or beta (Min Qty, Max Qty)	0.40		0.40	0.17		0.17	0.17		0.17	0.17		0.17	0.17		0.17
Quantity Unit:	Each			Each			Each			Each			Each		
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.82E-01	1.65E+00	2.65E+00	2.87E+01	3.38E+01	4.41E+01	3.75E-01	4.41E-01	5.74E-01	4.69E+00	5.51E+00	7.17E+00	7.50E-01	8.82E-01	1.15E+00
Best fit mean:	1.65E+00 Normal			3.38E+01 LogNormal			4.41E-01 LogNormal			5.51E+00 LogNormal			8.82E-01 LogNormal		
Best Fit Distribution:															
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00	1.00		5.00	1.00		5.00
Average Repair Time (Min Qty, Max Qty)	1.82E+00		1.49E+00	5.64E+01		1.69E+01	4.85E-01		3.97E-01	6.07E+00		4.96E+00	9.71E-01		7.94E-01
CV or beta (Min Qty, Max Qty)	0.47		0.47	0.30		0.30	0.30		0.30	0.30		0.30	0.30		0.30
Quantity Unit:	Each			Each			Each			Each			Each		
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.7E+02	Normal	0.47	4.9E+04	LogNormal	0.30	1.7E+01	LogNormal	0.30	2.1E+02	LogNormal	0.30	2.3E+01	LogNormal	0.30
Embodied Energy (MJ)	5.0E+03	Normal	0.47	9.3E+05	LogNormal	0.30	3.7E+02	LogNormal	0.30	4.6E+03	LogNormal	0.30	4.3E+02	LogNormal	0.30
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO			NO		
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable			Not Applicable		
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00		0%	0.00	
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00		0%	0.00	
Post-event Tagging Flag:	NO			NO			NO			NO			NO		
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00		0%	0.00	

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5092.033g

Diesel generator - Capacity: 750 to 1200 kVA - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragility only

Costing is per unit and is based upon 1000 kVa.

Line 666

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

KV 1000

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

Mutually Exclusive

MutEx(DS1.DS2)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations



Damage State Probability:

0.70

0.30

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Long Lead Time (Yes / No)

YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.40E+03	2.20E+03	3.10E+03	3.25E+05	3.82E+05	4.99E+05									
Best fit mean:	2.23E+03			3.95E+05											
Best Fit Distribution:	Normal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00	5.00		1.00	5.00										
Average Repair Cost (Min Qty, Max Qty)	2.86E+03		1.98E+03	4.97E+05		3.44E+05									
CV or beta (Min Qty, Max Qty)	0.30		0.30	0.17		0.17									
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.44E+00	2.26E+00	3.19E+00	3.34E+01	3.94E+01	5.13E+01									
Best fit mean:	2.26E+00			3.94E+01											
Best Fit Distribution:	Normal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00	5.00		1.00	5.00										
Average Repair Time (Min Qty, Max Qty)	2.94E+00		2.04E+00	1.57E+02		1.97E+01									
CV or beta (Min Qty, Max Qty)	0.39		0.39	0.30		0.30									
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.5E+02	Normal	0.39	9.2E+04	LogNormal	0.30									
Embodied Energy (MJ)	7.4E+03	Normal	0.39	1.7E+06	LogNormal	0.30									
LifeSafety Hazard:	Potential non-collapse casualties? (Yes / No)			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

D5092.033h

Line 667


NISTIR Name	Description

Diesel generator - Capacity: 750 to 1200 kVA - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragility only
Costing is per unit and is based upon 1000 kVa.

Construction Quality:	Normal - Designed for seismic loads but no special seismic certification
Seismic Installation Conditions:	Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

Fragility Unit of Measure:		KV 1000		Allow sum by floor or building? BLDG Demand Location (floor above)? No	
Demand Parameter (unit):		Peak Floor Acceleration g			
Number of Damage States:		4			
Damage State:	DS1		DS2	DS3	DS4
Type of Damage State:	Mutually Exclusive		Mutually Exclusive	Mutually Exclusive	Mutually Exclusive
DS Hierarchy	MuEx(DS1, DS2, DS3, DS4)				
Descriptions	Damaged, inoperative but anchorage is OK. Pipes and nozzles damaged.		Damaged, inoperative but anchorage is OK. Drive shaft misalignment.	Damaged, inoperative but anchorage is OK. Minor electrical damage, e.g., failed relay.	Damaged, inoperative but anchorage is OK. Exhaust line disconnected at expansion bellows.

Illustrations

				
D5092.031b-DS1-1.JPG	none	none	none	

Damage State Probability:

Fragility Parameters					
Median Demand, θ_i :	2	2	2	2	
Data dispersion, β_d :	0.2	0.20	0.2	0.2	
Uncertainty, β_u :	0.1	0.1	0.1	0.1	
Total Dispersion, δ_i :	0.2	0.2	0.2	0.2	

Correlation (Yes / No)

Directionality (Yes / No)

NO	Data Quality Average	Documentation Quality Superior
NO	Data Relevance Average	Rationality Superior

Consequence Functions	Repair Description
-----------------------	--------------------

Repair fracture pipes and damaged nozzles.	Overhaul because of drive shaft misalignment.	Minor electrical repair e.g., replace relay.	Reconnect exhaust line
--	---	--	------------------------

Long Lead Time (Yes / No)	YES			YES			YES			YES		
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	7.70E+02	9.00E+02	1.17E+03	6.80E+03	8.00E+03	1.04E+04	1.02E+03	1.20E+03	1.56E+03	1.02E+03	1.20E+03	1.56E+03
Best fit mean:	9.32E+02 LogNormal			8.26E+03 LogNormal			1.24E+03 LogNormal			1.24E+03 LogNormal		
Best Fit Distribution:												
Quantity Plateau (Min Qty, Max Qty)	1.00	5.00		1.00	5.00		1.00	5.00		1.00	5.00	
Average Repair Cost (Min Qty, Max Qty)	1.17E+03	7.20E+02		1.04E+04	6.40E+03		1.44E+03	9.60E+02		1.44E+03	9.60E+02	
CV or beta (Min Qty, Max Qty)	0.17	0.17		0.17	0.17		0.17	0.17		0.17	0.17	
Quantity Unit:	Each			Each			Each			Each		
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.02E+00	1.19E+00	1.55E+00	9.00E+00	1.06E+01	1.38E+01	1.35E+00	1.59E+00	2.06E+00	1.35E+00	1.59E+00	2.06E+00
Best fit mean:	1.19E+00 LogNormal			1.06E+01 LogNormal			1.59E+00 LogNormal			1.59E+00 LogNormal		
Best Fit Distribution:												
Quantity Plateau (Min Qty, Max Qty)	1.00	5.00		1.00	5.00		1.00	5.00		1.00	5.00	
Average Repair Time (Min Qty, Max Qty)	1.55E+00	9.53E-01		1.38E+01	8.47E+00		1.91E+00	1.27E+00		1.91E+00	1.27E+00	
CV or beta (Min Qty, Max Qty)	0.30	0.30		0.30	0.30		0.30	0.30		0.30	0.30	
Quantity Unit:	Each			Each			Each			Each		
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	3.7E+01	LogNormal	0.30	3.3E+02	LogNormal	0.30	3.4E+01	LogNormal	0.30	5.0E+01	LogNormal	0.30
Embodied Energy (MJ)	8.2E+02	LogNormal	0.30	7.3E+03	LogNormal	0.30	6.5E+02	LogNormal	0.30	1.1E+03	LogNormal	0.30
LifeSafety Hazard:												
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO		
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable		
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00		
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00		
Post-event Tagging Flag:	NO			NO			NO			NO		
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00		

Comments:	None
Date Created:	Not Given
Approved (YES / NO)?	By User
Official (YES / NO) ?	By User
Author:	Not Given
Revisions:	None

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5092.033i

Diesel generator - Capacity: 750 to 1200 kVA - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage/isc

Costing is per unit and is based upon 1000 kVa.

Line 668

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

KV 1000

Peak Floor Acceleration g

5

DS1

Mutually Exclusive

MutEx(DS1.DS2,DS3,DS4,DS5)

Anchorage failure.

DS2

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

DS3

Mutually Exclusive

Damaged, inoperative but anchorage is OK

DS4

Mutually Exclusive

Equipment is damaged and inoperative but anchorage is OK.

DS5

Mutually Exclusive

Equipment is damaged and inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D5092.031a-DS1-1.JPG

none

none

none

none

0.35

0.15

0.40

0.05

0.05

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

By User

User to Calculate

User to Calculate

By User

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Repair fracture pipes & damaged nozzles, and or reconnect exhaust line.

Overhaul because of drive shaft misalignment. minor electrical repair e.g., replace relays.

Long Lead Time (Yes / No)

YES

YES

YES

YES

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.40E+03

2.20E+03

3.10E+03

2.23E+03

Normal

1.00

5.00

2.42E+03

1.98E+03

0.30

0.30

Each

P₁₀

P₅₀

P₉₀

3.25E+05

3.82E+05

4.99E+05

3.95E+05

LogNormal

1.00

5.00

4.21E+05

3.44E+05

0.17

0.17

Each

P₁₀

P₅₀

P₉₀

7.70E+02

9.00E+02

1.17E+03

9.32E+02

LogNormal

1.00

5.00

9.90E+02

8.10E+02

0.17

0.17

Each

P₁₀

P₅₀

P₉₀

6.80E+03

8.00E+03

1.04E+04

8.26E+03

LogNormal

1.00

5.00

8.80E+03

7.20E+03

0.17

0.17

Each

P₁₀

P₅₀

P₉₀

1.02E+03

1.20E+03

1.56E+03

1.24E+03

LogNormal

1.00

5.00

1.32E+03

1.08E+03

0.17

0.17

Each

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.54E+00

2.43E+00

3.42E+00

2.43E+00

Normal

1.00

5.00

2.67E+00

2.18E+00

0.39

0.39

Each

P₁₀

P₅₀

P₉₀

3.58E+01

4.22E+01

5.50E+01

4.22E+01

LogNormal

1.00

5.00

8.44E+01

2.11E+01

0.30

0.30

Each

P₁₀

P₅₀

P₉₀

8.49E-01

9.93E-01

1.29E+00

9.93E-01

LogNormal

1.00

5.00

1.09E+00

8.93E-01

0.30

0.30

Each

P₁₀

P₅₀

P₉₀

7.50E+00

8.82E+00

1.15E+01

8.82E+00

LogNormal

1.00

5.00

9.71E+00

7.94E+00

0.30

0.30

Each

P₁₀

P₅₀

P₉₀

1.13E+00

1.32E+00

1.72E+00

1.32E+00

LogNormal

1.00

5.00

1.46E+00

1.19E+00

0.30

0.30

Each

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

2.5E+02

Normal

0.39

9.2E+04

LogNormal

0.30

3.7E+01

LogNormal

0.30

3.3E+02

LogNormal

0.30

3.4E+01

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

7.4E+03

Normal

0.39

1.7E+06

LogNormal

0.30

8.2E+02

LogNormal

0.30

7.3E+03

LogNormal

0.30

6.5E+02

LogNormal

0.30

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5092.033j

Line 669

Diesel generator - Capacity: 1200 to 2000 kVa - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragility only

Costing is per unit and is based upon 1500 kVa.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

KV 1500

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

Mutually Exclusive

MutEx(DS1.DS2)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations



Damage State Probability:

0.70

0.30

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Long Lead Time (Yes / No)

YES YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.60E+03	2.40E+03	3.40E+03	4.84E+05	5.71E+05	7.43E+05									
Best fit mean:	2.36E+03			5.90E+05											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00			5.00											
Average Repair Cost (Min Qty, Max Qty)	3.12E+03			7.42E+05											
CV or beta (Min Qty, Max Qty)	0.29			0.17											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.65E+00	2.47E+00	3.50E+00	3.49E+01	4.11E+01	5.36E+01									
Best fit mean:	2.47E+00			4.11E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00			5.00											
Average Repair Time (Min Qty, Max Qty)	3.21E+00			2.17E+02											
CV or beta (Min Qty, Max Qty)	0.38			0.30											
Quantity Unit:	Each			Each											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	2.5E+02	LogNormal	0.38	1.4E+05	LogNormal	0.30									
Embodied Energy (MJ)	7.4E+03	LogNormal	0.38	2.6E+06	LogNormal	0.30									
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Date Generated:

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

D5092.033k

NISTIR Name
Description

Diesel generator - Capacity: 1200 to 2000 kVa - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragility only
Costing is per unit and is based upon 1500 kVa.

Line 670

Construction Quality:

Normal - Designed for seismic loads but no special seismic certification

Seismic Installation Conditions:


Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

Fragility Unit of Measure:	KV 1500
Demand Parameter (unit):	Peak Floor Acceleration g
Number of Damage States:	4

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?	BLDG	
Demand Location (floor above?)	No	

Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive	
DS Hierarchy	MutEx(DS1,DS2,DS3,DS4)				
Descriptions	Damaged, inoperative but anchorage is OK. Pipes and nozzles damaged.	Damaged, inoperative but anchorage is OK. Drive shaft misalignment.	Damaged, inoperative but anchorage is OK. Minor electrical damage, e.g., failed relay.	Damaged, inoperative but anchorage is OK. Exhaust line disconnected at expansion bellows.	

Illustrations

				
D5092.031b-DS1-1.JPG	none	none	none	
0.70	0.10	0.10	0.10	

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	2	2	2	2	
Data dispersion, β_d :	0.2	0.20	0.2	0.2	
Uncertainty, β_u :	0.1	0.1	0.1	0.1	
Total Dispersion, β :	0.2	0.2	0.2	0.2	
Correlation (Yes / No)	NO	Data Quality Average		Documentation Quality Superior	
Directionality (Yes / No)	NO	Data Relevance Average		Rationality Superior	

Consequence Functions

Repair Description

Repair fracture pipes and damaged nozzles. Overhaul because of drive shaft misalignment. Minor electrical repair e.g., replace relay. Reconnect exhaust line.

Long Lead Time (Yes / No)

YES YES YES YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.28E+03	1.50E+03	1.95E+03	8.50E+03	1.00E+04	1.30E+04	1.02E+03	1.20E+03	1.56E+03	1.02E+03	1.20E+03	1.56E+03			
Best fit mean:	1.55E+03			1.03E+04			1.24E+03			1.24E+03					
Best Fit Distribution:	LogNormal			LogNormal			LogNormal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00	1.00		5.00			
Average Repair Cost (Min Qty, Max Qty)	1.65E+03		1.05E+03	1.10E+04		9.00E+03	1.32E+03		1.08E+03	1.32E+03		1.08E+03			
CV or beta (Min Qty, Max Qty)	0.17		0.17	0.17		0.17	0.17		0.17	0.17		0.17			
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.88E-01	2.21E-01	2.87E-01	1.25E+00	1.47E+00	1.91E+00	1.50E-01	1.77E-01	2.29E-01	1.50E-01	1.77E-01	2.29E-01			
Best fit mean:	2.21E-01			1.47E+00			1.77E-01			1.77E-01					
Best Fit Distribution:	LogNormal			LogNormal			LogNormal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00	1.00		5.00			
Average Repair Time (Min Qty, Max Qty)	2.43E-01		1.54E-01	1.62E+00		1.32E+00	1.94E-01		1.59E-01	1.94E-01		1.59E-01			
CV or beta (Min Qty, Max Qty)	0.30		0.30	0.30		0.30	0.30		0.30	0.30		0.30			
Quantity Unit:	Each			Each			Each			Each					
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	6.2E+01	LogNormal	0.30	4.1E+02	LogNormal	0.30	3.4E+01	LogNormal	0.30	5.0E+01	LogNormal	0.30			
Embodied Energy (MJ)	1.4E+03	LogNormal	0.30	9.1E+03	LogNormal	0.30	6.5E+02	LogNormal	0.30	1.1E+03	LogNormal	0.30			
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00				
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00				
Post-event Tagging Flag:	NO			NO			NO			NO					
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00				

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

None

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5092.033I

Diesel generator - Capacity: 1200 to 2000 kVa - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage/is

Costing is per unit and is based upon 1500 kVa.

Line 671

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

KV 1500

Peak Floor Acceleration

g

5

DS1

Mutually Exclusive

MutEx(DS1,DS2,DS3,DS4,DS5)

Anchorage failure.

DS2

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

DS3

Mutually Exclusive

Damaged, inoperative but anchorage is OK

DS4

Mutually Exclusive

Equipment is damaged and inoperative but anchorage is OK.

DS5

Mutually Exclusive

Equipment is damaged and inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D5092.031a-DS1-1.JPG

none

none

none

none

0.35

0.15

0.40

0.05

0.05

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

By User

User to Calculate

User to Calculate

By User

NO

NO

Data Quality

Average

Documentation Quality

Superior

Data Relevance

Average

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Repair fracture pipes & damaged nozzles, and or reconnect exhaust line.

Overhaul because of drive shaft misalignment. minor electrical repair e.g., replace relays.

Long Lead Time (Yes / No)

YES

YES

YES

YES

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

1.60E+03

2.40E+03

3.40E+03

LogNormal

1.00

5.00

3.12E+03

0.29

Each

P₁₀

P₅₀

P₉₀

4.84E+05

5.71E+05

7.43E+05

LogNormal

1.00

5.00

7.42E+05

0.17

Each

P₁₀

P₅₀

P₉₀

1.28E+03

1.50E+03

1.95E+03

LogNormal

1.00

5.00

1.95E+03

0.17

Each

P₁₀

P₅₀

P₉₀

8.50E+03

1.00E+04

1.30E+04

LogNormal

1.00

5.00

1.30E+04

0.17

Each

P₁₀

P₅₀

P₉₀

1.02E+03

1.20E+03

1.56E+03

LogNormal

1.00

5.00

1.56E+03

0.17

Each

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

P₁₀

P₅₀

P₉₀

2.35E-01

3.53E-01

5.00E-01

LogNormal

1.00

5.00

4.59E-01

0.38

Each

P₁₀

P₅₀

P₉₀

4.98E+00

5.88E+00

7.65E+00

LogNormal

1.00

5.00

3.11E+01

0.30

Each

P₁₀

P₅₀

P₉₀

1.88E-01

2.21E-01

2.87E-01

LogNormal

1.00

5.00

2.87E-01

0.30

Each

P₁₀

P₅₀

P₉₀

1.25E+00

1.47E+00

1.91E+00

LogNormal

1.00

5.00

1.91E+00

0.30

Each

P₁₀

P₅₀

P₉₀

1.50E-01

1.77E-01

2.29E-01

LogNormal

1.00

5.00

2.29E-01

0.30

Each

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

Median Cost

Best Fit

CV or Beta

2.5E+02

LogNormal

0.38

Median Cost

Best Fit

CV or Beta

1.4E+05

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

6.2E+01

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

4.1E+02

LogNormal

0.30

Median Cost

Best Fit

CV or Beta

3.4E+01

LogNormal

0.30

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

NO

0%

0.00

NO

Not Applicable

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

1

02/26/19

Comments:	This component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent actual consequence.		
Date Created:	Not Given	Root Cost Multiplier:	1
Approved (YES / NO)?	By User	Date Generated:	02/26/19
Official (YES / NO) ?	By User		
Author:	Not Given		
Revisions:	None		

FEMA P-58 Fragility Specification

NISTIR Classification

E2022.010

NISTIR Name

Unsecured fragile objects on shelves, unknown restraint

Description

Costing to be furnished by user. Consequence data assumes 16 SF of damage area.

Line 673

Construction Quality:

Any

Seismic Installation Conditions:

Unknown conditions: some objects may have museum putty. Some cabinets may have latches. Some cabinets may be secured.

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Peak Floor Acceleration g

Number of Damage States:

1

Damage State:

DS1

Type of Damage State:

Sequential

DS Hierarchy

Seq(DS1)

Descriptions

Object falls off shelf or shelf overturns and object breaks or object breaks within cabinet.

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	NO	

Illustrations

				
E2022.010-DS1-1.JPG				

Damage State Probability:

1.00

Fragility Parameters

Median Demand, θ :

0.4

Data dispersion, β_d :

0.4

Uncertainty, β_u :

0.3

Total Dispersion, β :

0.6

Correlation (Yes / No)

NO

Directionality (Yes / No)

NO

Data Quality Not Rated

Data Relevance Not Rated

Documentation Quality Not Rated

Rationality Not Rated

Consequence Functions

Repair Description

Replace object. Note: user must supply cost of replacement.

Long Lead Time (Yes / No)

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:		BY USER													
Best Fit Distribution:		BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER		BY USER												
Average Repair Cost (Min Qty, Max Qty)	BY USER		BY USER												
CV or beta (Min Qty, Max Qty)	BY USER		BY USER												
Quantity Unit:		BY USER													
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:		BY USER													
Best Fit Distribution:		BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER		BY USER												
Average Repair Time (Min Qty, Max Qty)	BY USER		BY USER												
CV or beta (Min Qty, Max Qty)	BY USER		BY USER												
Quantity Unit:		BY USER													
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	BY USER	BY USER	BY USER												
Embodied Energy (MJ)	BY USER	BY USER	BY USER												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)		YES													
Casualty-affected Planar Area (sf) per Normative Unit:		16 SF													
Serious Injury (Median, Dispersion)	10%	0.50													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:		NO													
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments:

This component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent actual consequence.

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

None

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

E2022.011

NISTIR Name

Fragile contents secured by museum putty, Velcro or other weak but sticky stuff

Description

Costing to be furnished by user. Consequence data assumes 16 SF of damage area.

Line 674

Construction Quality:

Any

Seismic Installation Conditions:

High adhesion surface (e.g., museum putty) and secured in cabinets (e.g., with latches & cabinet is secured to wall)

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Peak Floor Acceleration g

Number of Damage States:

1

Damage State:

DS1

Type of Damage State:

Sequential

DS Hierarchy

Seq(DS1)

Descriptions

Object falls off shelf or shelf overturns and object breaks or object breaks within cabinet.

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	No	

Illustrations



Damage State Probability:

1.00

Fragility Parameters

Median Demand, θ :

1

Data dispersion, β_d :

0.4

Uncertainty, β_u :

0.3

Total Dispersion, β :

0.5

Correlation (Yes / No)

NO

Directionality (Yes / No)

NO

Data Quality Not Rated

Data Relevance Not Rated

Documentation Quality Not Rated

Rationality Not Rated

Consequence Functions

Repair Description

Replace object. Note: user must supply cost of replacement.

Long Lead Time (Yes / No)

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER													
Best Fit Distribution:	BY USER	BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER													
Average Repair Cost (Min Qty, Max Qty)	BY USER	BY USER													
CV or beta (Min Qty, Max Qty)	BY USER	BY USER													
Quantity Unit:	BY USER	BY USER													
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER													
Best Fit Distribution:	BY USER	BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER													
Average Repair Time (Min Qty, Max Qty)	BY USER	BY USER													
CV or beta (Min Qty, Max Qty)	BY USER	BY USER													
Quantity Unit:	BY USER	BY USER													
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	BY USER	BY USER	BY USER												
Embodied Energy (MJ)	BY USER	BY USER	BY USER												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)		YES													
Casualty-affected Planar Area (sf) per Normative Unit:		16 SF													
Serious Injury (Median, Dispersion)	10%	0.50													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:		NO													
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments:

This component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent actual consequence.

Date Created:

Not Given

Root Cost Multiplier:

1

Approved (YES / NO)?

By User

Date Generated:

02/26/19

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

None

FEMA P-58 Fragility Specification

NISTIR Classification

E2022.012

NISTIR Name

Fragile contents on shelves in storage cabinets with latches

Description

Costing to be furnished by user. Consequence data assumes 16 SF of damage area.

Line 675

Construction Quality:

Any

Seismic Installation Conditions:

In secured cabinets (e.g., with latches)

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Peak Floor Acceleration g

Number of Damage States:

1

Damage State:

DS1

Type of Damage State:

Sequential

DS Hierarchy

Seq(DS1)

Descriptions

Object falls off shelf or shelf overturns
and object breaks or object breaks
within cabinet.

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

				
E2022.010-DS1-1.JPG				

Damage State Probability:

1.00

Fragility Parameters

Median Demand, θ :

0.6

Data dispersion, β_d :

0.5

Uncertainty, β_u :

0.3

Total Dispersion, β :

0.6

Correlation (Yes / No)

NO

Directionality (Yes / No)

NO

Data Quality Not Rated

Data Relevance Not Rated

Documentation Quality Not Rated

Rationality Not Rated

Consequence Functions

Repair Description

Replace object. Note: user must supply cost
of replacement.

Long Lead Time (Yes / No)

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:		BY USER													
Best Fit Distribution:		BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER		BY USER												
Average Repair Cost (Min Qty, Max Qty)	BY USER		BY USER												
CV or beta (Min Qty, Max Qty)	BY USER		BY USER												
Quantity Unit:		BY USER													
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:		BY USER													
Best Fit Distribution:		BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER		BY USER												
Average Repair Time (Min Qty, Max Qty)	BY USER		BY USER												
CV or beta (Min Qty, Max Qty)	BY USER		BY USER												
Quantity Unit:		BY USER													
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	BY USER	BY USER	BY USER												
Embodied Energy (MJ)	BY USER	BY USER	BY USER												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)		YES													
Casualty-affected Planar Area (sf) per Normative Unit:		16 SF													
Serious Injury (Median, Dispersion)	5%	0.50													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:		NO													
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments:

This component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent actual consequence.

Date Created:

Not Given

Root Cost Multiplier:

1

Approved (YES / NO)?

By User

Date Generated:

02/26/19

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

None

FEMA P-58 Fragility Specification

NISTIR Classification
NISTIR Name
Description

E2022.013
Unsecured fragile objects on shelves, low friction surface
Costing to be furnished by user. Consequence data assumes 16 SF of damage area.

Line 676

Construction Quality: Any
Seismic Installation Conditions: Low friction coefficient (e.g., glass or metal on wood), in unsecured cabinets (e.g., no latches)
Fragility Unit of Measure: EA 1
Demand Parameter (unit): Peak Floor Acceleration g
Number of Damage States: 1
Damage State: DS1
Type of Damage State: Sequential
DS Hierarchy: Seq(DS1)
Descriptions: Object falls off shelf or shelf overturns and object breaks or object breaks within cabinet.

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00				
Fragility Parameters					
Median Demand, θ :	0.25				
Data dispersion, β_d :	0.4				
Uncertainty, β_u :	0.3				
Total Dispersion, β :	0.5				
Correlation (Yes / No)	NO		Data Quality Not Rated		Documentation Quality Not Rated
Directionality (Yes / No)	NO		Data Relevance Not Rated		Rationality Not Rated

Consequence Functions
Repair Description
Replace object. Note: user must supply cost of replacement.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:		BY USER													
Best Fit Distribution:		BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER		BY USER												
Average Repair Cost (Min Qty, Max Qty)	BY USER		BY USER												
CV or beta (Min Qty, Max Qty)	BY USER		BY USER												
Quantity Unit:		BY USER													
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:		BY USER													
Best Fit Distribution:		BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER		BY USER												
Average Repair Time (Min Qty, Max Qty)	BY USER		BY USER												
CV or beta (Min Qty, Max Qty)	BY USER		BY USER												
Quantity Unit:		BY USER													
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	BY USER	BY USER	BY USER												
Embodied Energy (MJ)	BY USER	BY USER	BY USER												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)		YES													
Casualty-affected Planar Area (sf) per Normative Unit:		16 SF													
Serious Injury (Median, Dispersion)	10%	0.50													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:		NO													
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments: This component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent actual consequence.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: None
Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification E2022.020
NISTIR Name Home entertainment equipment, unknown installation
Description Costing to be furnished by user. Consequence data assumes 16 SF of damage area.

Line 677

Construction Quality: Any

Seismic Installation Conditions: Unknown

Quantity Rounding Round Qty? NO

Fragility Unit of Measure: EA 1

Allow sum by floor or building? NO

Demand Parameter (unit): Peak Floor Acceleration g

Demand Location (floor above?) No

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy: Seq(DS1)

Descriptions: Falls, does not function.

Illustrations



E2022.020-DS1-1.JPG

Damage State Probability: 1.00

Fragility Parameters

Median Demand, θ : 0.8

Data dispersion, β_d : 0.4

Uncertainty, β_u : 0.25

Total Dispersion, β : 0.45

Correlation (Yes / No) NO

Data Quality Not Rated

Documentation Quality Not Rated

Directionality (Yes / No) NO

Data Relevance Not Rated

Rationality Not Rated

Consequence Functions

Repair Description: Replace equipment. User must supply replacement cost.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER														
Best Fit Distribution:	BY USER														
Quantity Plateau (Min Qty, Max Qty)	BY USER														
Average Repair Cost (Min Qty, Max Qty)	BY USER														
CV or beta (Min Qty, Max Qty)	BY USER														
Quantity Unit:	BY USER														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER														
Best Fit Distribution:	BY USER														
Quantity Plateau (Min Qty, Max Qty)	BY USER														
Average Repair Time (Min Qty, Max Qty)	BY USER														
CV or beta (Min Qty, Max Qty)	BY USER														
Quantity Unit:	BY USER														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	BY USER	BY USER	BY USER												
Embodied Energy (MJ)	BY USER	BY USER	BY USER												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	YES														
Casualty-affected Planar Area (sf) per Normative Unit:	16 SF														
Serious Injury (Median, Dispersion)	10%	0.50													
Loss of Life (Median, Dispersion)	5%	0.50													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments: This component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent actual consequence.

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Not Given

Revisions: None

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification E2022.021
NISTIR Name Electronic equipment on wall mount brackets
Description Costing to be furnished by user. Consequence data assumes 16 SF of damage area.

Line 678

Construction Quality: Any

Seismic Installation Conditions: Unsecured

Quantity Rounding Round Qty? NO

Fragility Unit of Measure: EA 1

Allow sum by floor or building? NO

Demand Parameter (unit): Peak Floor Acceleration g

Demand Location (floor above?) No

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy Seq(DS1)

Descriptions Falls, does not function.

Illustrations



Damage State Probability: 1.00

Fragility Parameters

Median Demand, θ : 2.5

Data dispersion, β_d : 0.4

Uncertainty, β_u : 0.3

Total Dispersion, β : 0.5

Correlation (Yes / No) NO

Data Quality Not Rated

Documentation Quality Not Rated

Directionality (Yes / No) NO

Data Relevance Not Rated

Rationality Not Rated

Consequence Functions

Repair Description Replace equipment. User must supply replacement cost.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER														
Best Fit Distribution:	BY USER														
Quantity Plateau (Min Qty, Max Qty)	BY USER														
Average Repair Cost (Min Qty, Max Qty)	BY USER														
CV or beta (Min Qty, Max Qty)	BY USER														
Quantity Unit:	BY USER														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER														
Best Fit Distribution:	BY USER														
Quantity Plateau (Min Qty, Max Qty)	BY USER														
Average Repair Time (Min Qty, Max Qty)	BY USER														
CV or beta (Min Qty, Max Qty)	BY USER														
Quantity Unit:	BY USER														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	BY USER	BY USER	BY USER												
Embodied Energy (MJ)	BY USER	BY USER	BY USER												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	YES														
Casualty-affected Planar Area (sf) per Normative Unit:	16 SF														
Serious Injury (Median, Dispersion)	20%	0.50													
Loss of Life (Median, Dispersion)	10%	0.50													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments: This component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent actual consequence.

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Not Given

Revisions: None

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

E2022.022

NISTIR Name
Description

Desktop electronics including computers, monitors, stereos, etc on a slip resistant surface
Costing to be furnished by user. Consequence data assumes 16 SF of damage area.

Line 679

Construction Quality: Any

Seismic Installation Conditions: Unsecured

Fragility Unit of Measure: EA 1

Demand Parameter (unit): Peak Floor Acceleration g

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy: Seq(DS1)

Descriptions: Falls, does not function.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations



Damage State Probability: 1.00

Fragility Parameters

Median Demand, θ : 1

Data dispersion, β_d : 0.4

Uncertainty, β_u : 0.3

Total Dispersion, β : 0.5

Correlation (Yes / No) NO

Directionality (Yes / No) NO

Data Quality Not Rated

Data Relevance Not Rated

Documentation Quality Not Rated

Rationality Not Rated

Consequence Functions
Repair Description

Replace equipment. User must supply replacement cost.

Long Lead Time (Yes / No)

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:		BY USER													
Best Fit Distribution:		BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER		BY USER												
Average Repair Cost (Min Qty, Max Qty)	BY USER		BY USER												
CV or beta (Min Qty, Max Qty)	BY USER		BY USER												
Quantity Unit:		BY USER													
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:		BY USER													
Best Fit Distribution:		BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER		BY USER												
Average Repair Time (Min Qty, Max Qty)	BY USER		BY USER												
CV or beta (Min Qty, Max Qty)	BY USER		BY USER												
Quantity Unit:		BY USER													
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	BY USER	BY USER	BY USER												
Embodied Energy (MJ)	BY USER	BY USER	BY USER												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)		YES													
Casualty-affected Planar Area (sf) per Normative Unit:		16 SF													
Serious Injury (Median, Dispersion)	10%	0.50													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:		NO													
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments:

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Not Given

Revisions: None

This component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent actual consequence.

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

E2022.023

NISTIR Name
Description

Desktop electronics including computers, monitors, stereos, etc, smooth surface
Costing to be furnished by user. Consequence data assumes 16 SF of damage area.

Line 680

Construction Quality: Any

Seismic Installation Conditions: Unsecured

Quantity Rounding Round Qty? NO

Fragility Unit of Measure: EA 1

Allow sum by floor or building? NO

Demand Parameter (unit): Peak Floor Acceleration g

Demand Location (floor above?) No

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy: Seq(DS1)

Descriptions: Falls, does not function.

Illustrations



Damage State Probability: 1.00

Fragility Parameters

Median Demand, θ : 0.4

Data dispersion, β_d : 0.4

Uncertainty, β_u : 0.3

Total Dispersion, β : 0.5

Correlation (Yes / No) NO

Directionality (Yes / No) NO

Data Quality Not Rated

Data Relevance Not Rated

Documentation Quality Not Rated

Rationality Not Rated

Consequence Functions
Repair Description

Replace equipment. User must supply replacement cost.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Environmental Impacts:

Embodied Carbon (kg CO2eq)

Embodied Energy (MJ)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments: This component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent actual consequence.

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Not Given

Revisions: None

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification E2022.102a
NISTIR Name Bookcase, 2 shelves, unanchored laterally
Description Standard bookcase, unanchored laterally. Bookcase is 12-5/8" deep x 29" tall

Line 681

Construction Quality: Normal

Seismic Installation Conditions: Unsecured

Quantity Rounding Round Qty? NO

Fragility Unit of Measure: EA 1

Allow sum by floor or building? NO

Demand Parameter (unit): Peak Floor Velocity meter/sec

Demand Location (floor above?) No

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy Seq(DS1)

Descriptions Book case falls over and contents are scattered. Likely damage to bookcase.

Illustrations					
	none				
	1.00				

Damage State Probability:

Fragility Parameters

Median Demand, θ : 0.724

Data dispersion, β_d : User to Calculate

Uncertainty, β_u : User to Calculate

Total Dispersion, β : 0.5

Correlation (Yes / No) NO

Data Quality Not Rated

Documentation Quality Not Rated

Directionality (Yes / No) NO

Data Relevance Not Rated

Rationality Not Rated

Consequence Functions

Repair Description Replace bookcase and restack / replace contents.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER													
Best Fit Distribution:	BY USER	BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER													
Average Repair Cost (Min Qty, Max Qty)	BY USER	BY USER													
CV or beta (Min Qty, Max Qty)	BY USER	BY USER													
Quantity Unit:	BY USER														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER													
Best Fit Distribution:	BY USER	BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER													
Average Repair Time (Min Qty, Max Qty)	BY USER	BY USER													
CV or beta (Min Qty, Max Qty)	BY USER	BY USER													
Quantity Unit:	BY USER														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	BY USER	BY USER	BY USER												
Embodied Energy (MJ)	BY USER	BY USER	BY USER												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)		NO													
Casualty-affected Planar Area (sf) per Normative Unit:		Not Applicable													
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:		NO													
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments: the ground motion only. This component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Not Given

Revisions: None

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification E2022.102b
NISTIR Name Bookcase, 2 shelves, anchored laterally
Description Standard bookcase, anchored laterally. Bookcase is 12-5/8" deep x 29" tall.

Line 682

Construction Quality: Normal

Seismic Installation Conditions: Secured

Quantity Rounding Round Qty? NO

Fragility Unit of Measure: EA 1

Allow sum by floor or building? NO

Demand Parameter (unit): Peak Floor Acceleration g

Demand Location (floor above?) No

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy Seq(DS1)

Descriptions Book case falls over and contents are scattered. Likely damage to bookcase.

Illustrations					
	none				
	1.00				

Damage State Probability:

Fragility Parameters

Median Demand, θ : By User

Data dispersion, β_d : User to Calculate

Uncertainty, β_u : User to Calculate

Total Dispersion, β : By User

Correlation (Yes / No) NO

Directionality (Yes / No) NO

Data Quality Not Rated

Data Relevance Not Rated

Documentation Quality Not Rated

Rationality Not Rated

Consequence Functions

Repair Description Replace bookcase and restack / replace contents.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER	BY USER												
Best Fit Distribution:	BY USER	BY USER	BY USER												
Quantity Plateau (Min Qty, Max Qty)	BY USER		BY USER												
Average Repair Cost (Min Qty, Max Qty)	BY USER		BY USER												
CV or beta (Min Qty, Max Qty)	BY USER		BY USER												
Quantity Unit:	BY USER		BY USER												
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER	BY USER												
Best Fit Distribution:	BY USER	BY USER	BY USER												
Quantity Plateau (Min Qty, Max Qty)	BY USER		BY USER												
Average Repair Time (Min Qty, Max Qty)	BY USER		BY USER												
CV or beta (Min Qty, Max Qty)	BY USER		BY USER												
Quantity Unit:	BY USER		BY USER												
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	BY USER	BY USER	BY USER												
Embodied Energy (MJ)	BY USER	BY USER	BY USER												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)			NO												
Casualty-affected Planar Area (sf) per Normative Unit:			Not Applicable												
Serious Injury (Median, Dispersion)	0%		0.00												
Loss of Life (Median, Dispersion)	0%		0.00												
Post-event Tagging Flag:			NO												
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00												

Comments: component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent actual consequence.

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Not Given

Revisions: None

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification E2022.103a
NISTIR Name Bookcase, 3 shelves, unanchored laterally
Description Standard bookcase, unanchored laterally. Bookcase is 12-5/8" deep x 41" tall

Line 683

Construction Quality: Normal

Seismic Installation Conditions: Unsecured

Quantity Rounding Round Qty? NO

Fragility Unit of Measure: EA 1

Allow sum by floor or building? NO

Demand Parameter (unit): Peak Floor Velocity meter/sec

Demand Location (floor above?) No

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy Seq(DS1)

Descriptions Book case falls over and contents are scattered. Likely damage to bookcase.

Illustrations					
	none				
	1.00				

Damage State Probability:

Fragility Parameters

Median Demand, θ : 0.493

Data dispersion, β_d : User to Calculate

Uncertainty, β_u : User to Calculate

Total Dispersion, β : 0.5

Correlation (Yes / No) NO

Data Quality Not Rated

Documentation Quality Not Rated

Directionality (Yes / No) NO

Data Relevance Not Rated

Rationality Not Rated

Consequence Functions

Repair Description Replace bookcase and restack / replace contents.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER													
Best Fit Distribution:	BY USER	BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER													
Average Repair Cost (Min Qty, Max Qty)	BY USER	BY USER													
CV or beta (Min Qty, Max Qty)	BY USER	BY USER													
Quantity Unit:	BY USER														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER													
Best Fit Distribution:	BY USER	BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER													
Average Repair Time (Min Qty, Max Qty)	BY USER	BY USER													
CV or beta (Min Qty, Max Qty)	BY USER	BY USER													
Quantity Unit:	BY USER														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	BY USER	BY USER	BY USER												
Embodied Energy (MJ)	BY USER	BY USER	BY USER												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)		NO													
Casualty-affected Planar Area (sf) per Normative Unit:		Not Applicable													
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:		NO													
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments: the ground motion only. This component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Not Given

Revisions: None

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification E2022.103b
NISTIR Name Bookcase, 3 shelves, anchored laterally
Description Standard bookcase, anchored laterally. Bookcase is 12-5/8" deep x 41" tall.

Line 684

Construction Quality:	Normal				
Seismic Installation Conditions:	Secured				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	1				
Damage State:	DS1				
Type of Damage State:	Sequential				
DS Hierarchy	Seq(DS1)				
Descriptions	Book case falls over and contents are scattered. Likely damage to bookcase.				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Illustrations

none				
1.00				

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	By User				
Data dispersion, β_d :	User to Calculate				
Uncertainty, β_u :	User to Calculate				
Total Dispersion, β :	By User				
Correlation (Yes / No)	NO	Data Quality	Not Rated	Documentation Quality	Not Rated
Directionality (Yes / No)	NO	Data Relevance	Not Rated	Rationality	Not Rated

Consequence Functions
Repair Description Replace bookcase and restack / replace contents.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER													
Best Fit Distribution:	BY USER	BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER													
Average Repair Cost (Min Qty, Max Qty)	BY USER	BY USER													
CV or beta (Min Qty, Max Qty)	BY USER	BY USER													
Quantity Unit:	BY USER														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER													
Best Fit Distribution:	BY USER	BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER													
Average Repair Time (Min Qty, Max Qty)	BY USER	BY USER													
CV or beta (Min Qty, Max Qty)	BY USER	BY USER													
Quantity Unit:	BY USER														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	BY USER	BY USER	BY USER												
Embodied Energy (MJ)	BY USER	BY USER	BY USER												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments: component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent actual consequence.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: None
Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification E2022.104a
NISTIR Name Bookcase, 4 shelves, unanchored laterally
Description Standard bookcase, unanchored laterally. Bookcase is 12-5/8" deep x 56" tall

Line 685

Construction Quality: Normal

Seismic Installation Conditions: Unsecured

Quantity Rounding Round Qty? NO

Fragility Unit of Measure: EA 1

Allow sum by floor or building? NO

Demand Parameter (unit): Peak Floor Velocity meter/sec

Demand Location (floor above?) No

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy Seq(DS1)

Descriptions Book case falls over and contents are scattered. Likely damage to bookcase.

Illustrations					
	none				
	1.00				

Damage State Probability:

Fragility Parameters

Median Demand, θ : 0.361

Data dispersion, β_d : User to Calculate

Uncertainty, β_u : User to Calculate

Total Dispersion, β : 0.5

Correlation (Yes / No) NO

Data Quality Not Rated

Documentation Quality Not Rated

Directionality (Yes / No) NO

Data Relevance Not Rated

Rationality Not Rated

Consequence Functions

Repair Description Replace bookcase and restack / replace contents.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER													
Best Fit Distribution:	BY USER	BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER													
Average Repair Cost (Min Qty, Max Qty)	BY USER	BY USER													
CV or beta (Min Qty, Max Qty)	BY USER	BY USER													
Quantity Unit:	BY USER														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER													
Best Fit Distribution:	BY USER	BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER													
Average Repair Time (Min Qty, Max Qty)	BY USER	BY USER													
CV or beta (Min Qty, Max Qty)	BY USER	BY USER													
Quantity Unit:	BY USER														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	BY USER	BY USER	BY USER												
Embodied Energy (MJ)	BY USER	BY USER	BY USER												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)		NO													
Casualty-affected Planar Area (sf) per Normative Unit:		Not Applicable													
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:		NO													
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments: the ground motion only. This component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Not Given

Revisions: None

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification E2022.104b
NISTIR Name Bookcase, 4 shelves, anchored laterally
Description Standard bookcase, anchored laterally. Bookcase is 12-5/8" deep x 56" tall.

Line 686

Construction Quality:	Normal				
Seismic Installation Conditions:	Secured				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	1				
Damage State:	DS1				
Type of Damage State:	Sequential				
DS Hierarchy	Seq(DS1)				
Descriptions	Book case falls over and contents are scattered. Likely damage to bookcase.				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Illustrations

none				
1.00				

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	By User				
Data dispersion, β_d :	User to Calculate				
Uncertainty, β_u :	User to Calculate				
Total Dispersion, β :	By User				
Correlation (Yes / No)	NO	Data Quality	Not Rated	Documentation Quality	Not Rated
Directionality (Yes / No)	NO	Data Relevance	Not Rated	Rationality	Not Rated

Consequence Functions
Repair Description Replace bookcase and restack / replace contents.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER													
Best Fit Distribution:	BY USER	BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER													
Average Repair Cost (Min Qty, Max Qty)	BY USER	BY USER													
CV or beta (Min Qty, Max Qty)	BY USER	BY USER													
Quantity Unit:	BY USER														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER													
Best Fit Distribution:	BY USER	BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER													
Average Repair Time (Min Qty, Max Qty)	BY USER	BY USER													
CV or beta (Min Qty, Max Qty)	BY USER	BY USER													
Quantity Unit:	BY USER														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	BY USER	BY USER	BY USER												
Embodied Energy (MJ)	BY USER	BY USER	BY USER												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments: component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent actual consequence.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: None
Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification E2022.105a
NISTIR Name Bookcase, 5 shelves, unanchored laterally
Description Standard bookcase, unanchored laterally. Bookcase is 12-5/8" deep x 71" tall

Line 687

Construction Quality: Normal

Seismic Installation Conditions: Unsecured

Quantity Rounding Round Qty? NO

Fragility Unit of Measure: EA 1

Allow sum by floor or building? NO

Demand Parameter (unit): Peak Floor Velocity meter/sec

Demand Location (floor above?) No

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy Seq(DS1)

Descriptions Book case falls over and contents are scattered. Likely damage to bookcase.

Illustrations					
	none				
	1.00				

Damage State Probability:

Fragility Parameters

Median Demand, θ : 0.29

Data dispersion, β_d : User to Calculate

Uncertainty, β_u : User to Calculate

Total Dispersion, β : 0.5

Correlation (Yes / No) NO

Directionality (Yes / No) NO

Data Quality Not Rated

Data Relevance Not Rated

Documentation Quality Not Rated

Rationality Not Rated

Consequence Functions

Repair Description Replace bookcase and restack / replace contents.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER													
Best Fit Distribution:	BY USER	BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER													
Average Repair Cost (Min Qty, Max Qty)	BY USER	BY USER													
CV or beta (Min Qty, Max Qty)	BY USER	BY USER													
Quantity Unit:	BY USER														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER													
Best Fit Distribution:	BY USER	BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER													
Average Repair Time (Min Qty, Max Qty)	BY USER	BY USER													
CV or beta (Min Qty, Max Qty)	BY USER	BY USER													
Quantity Unit:	BY USER														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	BY USER	BY USER	BY USER												
Embodied Energy (MJ)	BY USER	BY USER	BY USER												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)		YES													
Casualty-affected Planar Area (sf) per Normative Unit:		10 SF													
Serious Injury (Median, Dispersion)	By User	0.50													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:		NO													
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments: the ground motion only. This component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Not Given

Revisions: None

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification E2022.105b
NISTIR Name Bookcase, 5 shelves, anchored laterally
Description Standard bookcase, anchored laterally. Bookcase is 12-5/8" deep x 71" tall.

Line 688

Construction Quality: Normal

Seismic Installation Conditions: Secured

Quantity Rounding Round Qty? NO

Fragility Unit of Measure: EA 1

Allow sum by floor or building? NO

Demand Parameter (unit): Peak Floor Acceleration g

Demand Location (floor above?) No

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy Seq(DS1)

Descriptions Book case falls over and contents are scattered. Likely damage to bookcase.

Illustrations					
	none				
	1.00				

Damage State Probability:

Fragility Parameters

Median Demand, θ : By User

Data dispersion, β_d : User to Calculate

Uncertainty, β_u : User to Calculate

Total Dispersion, β : By User

Correlation (Yes / No) NO

Directionality (Yes / No) NO

Data Quality Not Rated

Data Relevance Not Rated

Documentation Quality Not Rated

Rationality Not Rated

Consequence Functions

Repair Description Replace bookcase and restack / replace contents.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER														
Best Fit Distribution:	BY USER														
Quantity Plateau (Min Qty, Max Qty)	BY USER		BY USER												
Average Repair Cost (Min Qty, Max Qty)	BY USER		BY USER												
CV or beta (Min Qty, Max Qty)	BY USER		BY USER												
Quantity Unit:	BY USER														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER														
Best Fit Distribution:	BY USER														
Quantity Plateau (Min Qty, Max Qty)	BY USER		BY USER												
Average Repair Time (Min Qty, Max Qty)	BY USER		BY USER												
CV or beta (Min Qty, Max Qty)	BY USER		BY USER												
Quantity Unit:	BY USER														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	BY USER	BY USER	BY USER												
Embodied Energy (MJ)	BY USER	BY USER	BY USER												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	YES														
Casualty-affected Planar Area (sf) per Normative Unit:	10 SF														
Serious Injury (Median, Dispersion)	By User	0.50	0.00												
Loss of Life (Median, Dispersion)	0%														
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments: component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent actual consequence.

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Not Given

Revisions: None

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification E2022.106a
NISTIR Name Bookcase, 6 shelves, unanchored laterally
Description Standard bookcase, unanchored laterally. Bookcase is 12-5/8" deep x 81-1/4" tall

Line 689

Construction Quality: Normal

Seismic Installation Conditions: Unsecured

Quantity Rounding Round Qty? NO

Fragility Unit of Measure: EA 1

Allow sum by floor or building? NO

Demand Parameter (unit): Peak Floor Velocity meter/sec

Demand Location (floor above?) No

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy Seq(DS1)

Descriptions Book case falls over and contents are scattered. Likely damage to bookcase.

Illustrations					
	none				
	1.00				

Damage State Probability:

Fragility Parameters

Median Demand, θ : 0.251

Data dispersion, β_d : User to Calculate

Uncertainty, β_u : User to Calculate

Total Dispersion, β : 0.5

Correlation (Yes / No) NO

Data Quality Not Rated

Documentation Quality Not Rated

Directionality (Yes / No) NO

Data Relevance Not Rated

Rationality Not Rated

Consequence Functions

Repair Description Replace bookcase and restack / replace contents.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER													
Best Fit Distribution:	BY USER	BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER													
Average Repair Cost (Min Qty, Max Qty)	BY USER	BY USER													
CV or beta (Min Qty, Max Qty)	BY USER	BY USER													
Quantity Unit:	BY USER														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER													
Best Fit Distribution:	BY USER	BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER													
Average Repair Time (Min Qty, Max Qty)	BY USER	BY USER													
CV or beta (Min Qty, Max Qty)	BY USER	BY USER													
Quantity Unit:	BY USER														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	BY USER	BY USER	BY USER												
Embodied Energy (MJ)	BY USER	BY USER	BY USER												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)		YES													
Casualty-affected Planar Area (sf) per Normative Unit:		20 SF													
Serious Injury (Median, Dispersion)	By User	0.50													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:		NO													
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments: the ground motion only. This component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Not Given

Revisions: None

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification E2022.106b
NISTIR Name Bookcase, 6 shelves, anchored laterally
Description Standard bookcase, anchored laterally. Bookcase is 12-5/8" deep x 81-1/4" tall.

Line 690

Construction Quality:	Normal				
Seismic Installation Conditions:	Secured				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	1				
Damage State:	DS1				
Type of Damage State:	Sequential				
DS Hierarchy	Seq(DS1)				
Descriptions	Book case falls over and contents are scattered. Likely damage to bookcase.				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Illustrations

none				
1.00				

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	By User				
Data dispersion, β_d :	User to Calculate				
Uncertainty, β_u :	User to Calculate				
Total Dispersion, β :	By User				
Correlation (Yes / No)	NO	Data Quality	Not Rated	Documentation Quality	Not Rated
Directionality (Yes / No)	NO	Data Relevance	Not Rated	Rationality	Not Rated

Consequence Functions
Repair Description Replace bookcase and restack / replace contents.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER													
Best Fit Distribution:	BY USER	BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER													
Average Repair Cost (Min Qty, Max Qty)	BY USER	BY USER													
CV or beta (Min Qty, Max Qty)	BY USER	BY USER													
Quantity Unit:	BY USER														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER													
Best Fit Distribution:	BY USER	BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER													
Average Repair Time (Min Qty, Max Qty)	BY USER	BY USER													
CV or beta (Min Qty, Max Qty)	BY USER	BY USER													
Quantity Unit:	BY USER														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	BY USER	BY USER	BY USER												
Embodied Energy (MJ)	BY USER	BY USER	BY USER												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)		YES													
Casualty-affected Planar Area (sf) per Normative Unit:		20 SF													
Serious Injury (Median, Dispersion)	By User	0.50													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:		NO													
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments: component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent actual consequence.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: None
Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

E2022.112a

Line 691

NISTIR Name

Vertical Filing Cabinet, 2 drawer, unanchored laterally

Description

Filing cabinet, unanchored laterally. Cabinet has 2 drawers and is 15" deep x 24" tall

Construction Quality:

Normal

Seismic Installation Conditions:

Unsecured

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Peak Floor Velocity

meter/sec

Number of Damage States:

1

Damage State:

DS1

Type of Damage State:

Sequential

DS Hierarchy

Seq(DS1)

Descriptions

Filing cabinet falls over and contents are scattered. Likely damage to file cabinet.

Quantity Rounding Round Qty? NO

Allow sum by floor or building? NO

Demand Location (floor above?) No

Illustrations

none				
1.00				

Damage State Probability:

Fragility Parameters

Median Demand, θ :

1.229

Data dispersion, β_d :

User to Calculate

Uncertainty, β_u :

User to Calculate

Total Dispersion, β :

0.5

Correlation (Yes / No)

NO

Directionality (Yes / No)

NO

Data Quality Not Rated

Data Relevance Not Rated

Documentation Quality Not Rated

Rationality Not Rated

Consequence Functions

Repair Description

Replace filing cabinet and refill / replace contents.

Long Lead Time (Yes / No)

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER	BY USER												
Best Fit Distribution:	BY USER	BY USER	BY USER												
Quantity Plateau (Min Qty, Max Qty)	BY USER		BY USER												
Average Repair Cost (Min Qty, Max Qty)	BY USER		BY USER												
CV or beta (Min Qty, Max Qty)	BY USER		BY USER												
Quantity Unit:	BY USER		BY USER												
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER	BY USER												
Best Fit Distribution:	BY USER	BY USER	BY USER												
Quantity Plateau (Min Qty, Max Qty)	BY USER		BY USER												
Average Repair Time (Min Qty, Max Qty)	BY USER		BY USER												
CV or beta (Min Qty, Max Qty)	BY USER		BY USER												
Quantity Unit:	BY USER		BY USER												
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	BY USER	BY USER	BY USER												
Embodied Energy (MJ)	BY USER	BY USER	BY USER												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)			NO												
Casualty-affected Planar Area (sf) per Normative Unit:			Not Applicable												
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:			NO												
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments:

the ground motion only. This component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent

Date Created:

Not Given

Root Cost Multiplier: 1

Approved (YES / NO)?

By User

Date Generated: 02/26/19

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

None

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

E2022.112b

Vertical Filing Cabinet, 2 drawer, anchored laterally

Filing cabinet, anchored laterally. Cabinet has 2 drawers and is 15" deep x 24" tall

Line 692

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

Secured

EA 1

Peak Floor Velocity

1

DS1

Sequential

Seq(DS1)

Filing cabinet falls over and contents are scattered. Likely damage to file cabinet.

meter/sec

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

No

No

No

No

Illustrations

none				
1.00				

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

By User

User to Calculate

User to Calculate

By User

NO

NO

Data Quality Not Rated

Data Relevance Not Rated

Documentation Quality Not Rated

Rationality Not Rated

Consequence Functions

Repair Description

Replace filing cabinet and refill / replace contents.

Long Lead Time (Yes / No)

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER													
Best Fit Distribution:	BY USER	BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER		BY USER												
Average Repair Cost (Min Qty, Max Qty)	BY USER		BY USER												
CV or beta (Min Qty, Max Qty)	BY USER		BY USER												
Quantity Unit:	BY USER														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER													
Best Fit Distribution:	BY USER	BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER		BY USER												
Average Repair Time (Min Qty, Max Qty)	BY USER		BY USER												
CV or beta (Min Qty, Max Qty)	BY USER		BY USER												
Quantity Unit:	BY USER														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	BY USER	BY USER	BY USER												
Embodied Energy (MJ)	BY USER	BY USER	BY USER												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)			NO												
Casualty-affected Planar Area (sf) per Normative Unit:			Not Applicable												
Serious Injury (Median, Dispersion)	0%		0.00												
Loss of Life (Median, Dispersion)	0%		0.00												
Post-event Tagging Flag:			NO												
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00												

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent actual consequence.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

Date Generated:

1

02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification E2022.114a
NISTIR Name Vertical Filing Cabinet, 4 drawer, unanchored laterally
Description Filing cabinet, unanchored laterally. Cabinet has 4 drawers and is 15" deep x 52" tall

Line 693

Construction Quality: Normal

Seismic Installation Conditions: Unsecured

Quantity Rounding Round Qty? NO

Fragility Unit of Measure: EA 1

Allow sum by floor or building? NO

Demand Parameter (unit): Peak Floor Velocity meter/sec

Demand Location (floor above?) No

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy Seq(DS1)

Descriptions Filing cabinet falls over and contents are scattered. Likely damage to file cabinet.

Illustrations					
	none				
	1.00				

Damage State Probability:

Fragility Parameters

Median Demand, θ : 0.498

Data dispersion, β_d : User to Calculate

Uncertainty, β_u : User to Calculate

Total Dispersion, β : 0.5

Correlation (Yes / No) NO

Data Quality Not Rated

Documentation Quality Not Rated

Directionality (Yes / No) NO

Data Relevance Not Rated

Rationality Not Rated

Consequence Functions

Repair Description Replace filing cabinet and refill / replace contents.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER													
Best Fit Distribution:	BY USER	BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER													
Average Repair Cost (Min Qty, Max Qty)	BY USER	BY USER													
CV or beta (Min Qty, Max Qty)	BY USER	BY USER													
Quantity Unit:	BY USER														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER													
Best Fit Distribution:	BY USER	BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER													
Average Repair Time (Min Qty, Max Qty)	BY USER	BY USER													
CV or beta (Min Qty, Max Qty)	BY USER	BY USER													
Quantity Unit:	BY USER														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	BY USER	BY USER	BY USER												
Embodied Energy (MJ)	BY USER	BY USER	BY USER												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)		YES													
Casualty-affected Planar Area (sf) per Normative Unit:		10 SF													
Serious Injury (Median, Dispersion)	By User	0.50													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:		NO													
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments: the ground motion only. This component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Not Given

Revisions: None

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification E2022.114b
NISTIR Name Vertical Filing Cabinet, 4 drawer, anchored laterally
Description Filing cabinet, anchored laterally. Cabinet has 4 drawers and is 15" deep x 52" tall

Line 694

Construction Quality: Normal

Seismic Installation Conditions: Secured

Quantity Rounding Round Qty? NO

Fragility Unit of Measure: EA 1

Allow sum by floor or building? NO

Demand Parameter (unit): Peak Floor Velocity meter/sec

Demand Location (floor above?) No

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy Seq(DS1)

Descriptions Filing cabinet falls over and contents are scattered. Likely damage to file cabinet.

Illustrations					
	none				
	1.00				

Damage State Probability:

Fragility Parameters

Median Demand, θ : By User

Data dispersion, β_d : User to Calculate

Uncertainty, β_u : User to Calculate

Total Dispersion, β : By User

Correlation (Yes / No) NO

Directionality (Yes / No) NO

Data Quality Not Rated

Data Relevance Not Rated

Documentation Quality Not Rated

Rationality Not Rated

Consequence Functions
Repair Description Replace filing cabinet and refill / replace contents.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER													
Best Fit Distribution:	BY USER	BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER													
Average Repair Cost (Min Qty, Max Qty)	BY USER	BY USER													
CV or beta (Min Qty, Max Qty)	BY USER	BY USER													
Quantity Unit:	BY USER														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER													
Best Fit Distribution:	BY USER	BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER													
Average Repair Time (Min Qty, Max Qty)	BY USER	BY USER													
CV or beta (Min Qty, Max Qty)	BY USER	BY USER													
Quantity Unit:	BY USER														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	BY USER	BY USER	BY USER												
Embodied Energy (MJ)	BY USER	BY USER	BY USER												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)		YES													
Casualty-affected Planar Area (sf) per Normative Unit:		10 SF													
Serious Injury (Median, Dispersion)	By User	0.50													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:		NO													
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments: component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent actual consequence.

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Not Given

Revisions: None

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

E2022.124a

Line 695

NISTIR Name

Lateral Filing Cabinet, 2 drawer, unanchored laterally

Description

Filing cabinet, unanchored laterally. Cabinet has 4 drawers and is 18.6" deep x 52.5" tall

Construction Quality:

Normal

Seismic Installation Conditions:

Unsecured

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Peak Floor Velocity

meter/sec

Number of Damage States:

1

Damage State:

DS1

Type of Damage State:

Sequential

DS Hierarchy

Seq(DS1)

Descriptions

Filing cabinet falls over and contents are scattered. Likely damage to file cabinet.

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	No	

Illustrations

none				
1.00				

Damage State Probability:

Fragility Parameters

Median Demand, θ :

0.688

Data dispersion, β_d :

User to Calculate

Uncertainty, β_u :

User to Calculate

Total Dispersion, β :

0.5

Correlation (Yes / No)

NO

Directionality (Yes / No)

NO

Data Quality Not Rated

Data Relevance Not Rated

Documentation Quality Not Rated

Rationality Not Rated

Consequence Functions

Repair Description

Replace filing cabinet and refill / replace contents.

Long Lead Time (Yes / No)

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:		BY USER													
Best Fit Distribution:		BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER		BY USER												
Average Repair Cost (Min Qty, Max Qty)	BY USER		BY USER												
CV or beta (Min Qty, Max Qty)	BY USER		BY USER												
Quantity Unit:		BY USER													
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:		BY USER													
Best Fit Distribution:		BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER		BY USER												
Average Repair Time (Min Qty, Max Qty)	BY USER		BY USER												
CV or beta (Min Qty, Max Qty)	BY USER		BY USER												
Quantity Unit:		BY USER													
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	BY USER	BY USER	BY USER												
Embodied Energy (MJ)	BY USER	BY USER	BY USER												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)		YES													
Casualty-affected Planar Area (sf) per Normative Unit:		10 SF													
Serious Injury (Median, Dispersion)	By User	0.50													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:		NO													
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments:

Comments: This component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent the ground motion only. This component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

None

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

E2022.124b

Line 696

NISTIR Name
Description

Lateral Filing Cabinet, 2 drawer, anchored laterally
Filing cabinet, anchored laterally. Cabinet has 4 drawers and is 18.6" deep x 52.5" tall

Construction Quality:
Seismic Installation Conditions:

Normal
Secured

Fragility Unit of Measure:	EA 1
Demand Parameter (unit):	Peak Floor Acceleration g
Number of Damage States:	1

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Damage State:	DS1				
Type of Damage State:	Sequential				
DS Hierarchy	Seq(DS1)				
Descriptions	Filing cabinet falls over and contents are scattered. Likely damage to file cabinet.				

Illustrations

none				
1.00				

Damage State Probability:

Fragility Parameters					
Median Demand, θ :	By User				
Data dispersion, β_d :	User to Calculate				
Uncertainty, β_u :	User to Calculate				
Total Dispersion, β :	By User				

Correlation (Yes / No)	NO	Data Quality	Not Rated	Documentation Quality	Not Rated
Directionality (Yes / No)	NO	Data Relevance	Not Rated	Rationality	Not Rated

Consequence Functions
Repair Description

Replace filing cabinet and refill / replace contents.

Long Lead Time (Yes / No)

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER														
Best Fit Distribution:	BY USER														
Quantity Plateau (Min Qty, Max Qty)	BY USER		BY USER												
Average Repair Cost (Min Qty, Max Qty)	BY USER		BY USER												
CV or beta (Min Qty, Max Qty)	BY USER		BY USER												
Quantity Unit:	BY USER														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER														
Best Fit Distribution:	BY USER														
Quantity Plateau (Min Qty, Max Qty)	BY USER		BY USER												
Average Repair Time (Min Qty, Max Qty)	BY USER		BY USER												
CV or beta (Min Qty, Max Qty)	BY USER		BY USER												
Quantity Unit:	BY USER														
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	BY USER	BY USER	BY USER												
Embodied Energy (MJ)	BY USER	BY USER	BY USER												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)		YES													
Casualty-affected Planar Area (sf) per Normative Unit:		10 SF													
Serious Injury (Median, Dispersion)	By User	0.50													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:		NO													
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments:

component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent actual consequence.

Date Created:
Approved (YES / NO)?
Official (YES / NO) ?
Author:
Revisions:

Not Given
By User
By User
Not Given
None

Root Cost Multiplier: 1
Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

E2022.125a

Line 697

NISTIR Name

Lateral Filing Cabinet, 4 drawer, unanchored laterally

Description

Filing cabinet, unanchored laterally. Cabinet has 5 drawers and is 18.6" deep x 67.75" tall

Construction Quality:

Normal

Seismic Installation Conditions:

Unsecured

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Peak Floor Velocity

meter/sec

Number of Damage States:

1

Damage State:

DS1

Type of Damage State:

Sequential

DS Hierarchy

Seq(DS1)

Descriptions

Filing cabinet falls over and contents are scattered. Likely damage to file cabinet.

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	No	

Illustrations

none				
1.00				

Damage State Probability:

Fragility Parameters

Median Demand, θ :

0.526

Data dispersion, β_d :

User to Calculate

Uncertainty, β_u :

User to Calculate

Total Dispersion, β :

0.5

Correlation (Yes / No)

NO

Directionality (Yes / No)

NO

Data Quality Not Rated

Data Relevance Not Rated

Documentation Quality Not Rated

Rationality Not Rated

Consequence Functions

Repair Description

Replace filing cabinet and refill / replace contents.

Long Lead Time (Yes / No)

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:		BY USER													
Best Fit Distribution:		BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER		BY USER												
Average Repair Cost (Min Qty, Max Qty)	BY USER		BY USER												
CV or beta (Min Qty, Max Qty)	BY USER		BY USER												
Quantity Unit:		BY USER													
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:		BY USER													
Best Fit Distribution:		BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER		BY USER												
Average Repair Time (Min Qty, Max Qty)	BY USER		BY USER												
CV or beta (Min Qty, Max Qty)	BY USER		BY USER												
Quantity Unit:		BY USER													
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO ₂ eq)	BY USER	BY USER	BY USER												
Embodied Energy (MJ)	BY USER	BY USER	BY USER												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)		YES													
Casualty-affected Planar Area (sf) per Normative Unit:		20 SF													
Serious Injury (Median, Dispersion)	By User	0.50													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:		NO													
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments:

Comments: This component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent the ground motion only. This component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

None

Root Cost Multiplier: 1

Date Generated: 02/26/19

FEMA P-58 Fragility Specification

NISTIR Classification

E2022.125b

NISTIR Name

Lateral Filing Cabinet, 4 drawer, anchored laterally

Description

Filing cabinet, anchored laterally. Cabinet has 5 drawers and is 18.6" deep x 67.75" tall

Line 698

Construction Quality:

Normal

Seismic Installation Conditions:

Secured

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Peak Floor Acceleration g

Number of Damage States:

1

Damage State:

DS1

Type of Damage State:

Sequential

DS Hierarchy

Seq(DS1)

Descriptions

Filing cabinet falls over and contents are scattered. Likely damage to file cabinet.

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

none					
1.00					

Damage State Probability:

Fragility Parameters

Median Demand, θ :

By User

Data dispersion, β_d :

User to Calculate

Uncertainty, β_u :

User to Calculate

Total Dispersion, β :

By User

Correlation (Yes / No)

NO

Directionality (Yes / No)

NO

Data Quality Not Rated

Data Relevance Not Rated

Documentation Quality Not Rated

Rationality Not Rated

Consequence Functions

Repair Description

Replace filing cabinet and refill / replace contents.

Long Lead Time (Yes / No)

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:		BY USER													
Best Fit Distribution:		BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER		BY USER												
Average Repair Cost (Min Qty, Max Qty)	BY USER		BY USER												
CV or beta (Min Qty, Max Qty)	BY USER		BY USER												
Quantity Unit:		BY USER													
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:		BY USER													
Best Fit Distribution:		BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER		BY USER												
Average Repair Time (Min Qty, Max Qty)	BY USER		BY USER												
CV or beta (Min Qty, Max Qty)	BY USER		BY USER												
Quantity Unit:		BY USER													
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	BY USER	BY USER	BY USER												
Embodied Energy (MJ)	BY USER	BY USER	BY USER												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)		YES													
Casualty-affected Planar Area (sf) per Normative Unit:		20 SF													
Serious Injury (Median, Dispersion)	By User	0.50													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:		NO													
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													

Comments:

component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent actual consequence.

Date Created:

Not Given

Root Cost Multiplier: 1

Approved (YES / NO)?

By User

Date Generated: 02/26/19

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

None

FEMA P-58 Fragility Specification

NISTIR Classification

F1012.001

Line 699


NISTIR Name
Description

Storage racks designed and installed before 2007, big box retail (12' to 15' tall)
Standard pallet back to back storage rack. Three to five levels tall with total height from 15 to 20 ft. Costing assumes one single side access rack. Costing of rack and restocking based upon 50 LF of rack.
Costing of rack contents to be furnished by user.

Construction Quality:	Normal				<div>Quantity RoundingRound Qty?NO</div> <div>Allow sum by floor or building?NO</div> <div>Demand Location (floor above?)No</div>
Seismic Installation Conditions:	Varies				
Fragility Unit of Measure:	LF 50				
Demand Parameter (unit):	Peak Floor Accelerationg				
Number of Damage States:	2				
Damage State:	DS1		DS2		
Type of Damage State:	Mutually Exclusive		Mutually Exclusive		
DS Hierarchy	MutEx(DS1,DS2)				
Descriptions	Significant merchandise shedding from rack shelves.		Significant structural damage to rack structure.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	NO	NO

Illustrations

				
F1012.001-DS1-1.JPG	F1012.001-DS2-1.JPG			
0.60	0.40			

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	0.42	0.42		
Data dispersion, β_d :	User to Calculate	User to Calculate		
Uncertainty, β_u :	User to Calculate	User to Calculate		
Total Dispersion, β :	0.4	0.4		
Correlation (Yes / No)	NO	Data Quality Average	Documentation Quality Average	
Directionality (Yes / No)	NO	Data Relevance Average	Rationality Average	

Consequence Functions

Repair Description

Minor repair to storage rack. Resort and restock shelves. Clean up debris.
Remove and replace storage rack system. Make minor repair to adjacent finishes. Resort and restock shelves. Clean up debris.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.15E+03	3.10E+03	5.20E+03	1.43E+04	1.87E+04	2.87E+04									
Best fit mean:	3.24E+03			1.96E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	26.00			26.00											
Average Repair Cost (Min Qty, Max Qty)	6.20E+03			3.73E+04											
CV or beta (Min Qty, Max Qty)	0.36			0.29											
Quantity Unit:	LF 50			LF 50											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.37E+00	3.42E+00	5.74E+00	1.57E+01	2.06E+01	3.17E+01									
Best fit mean:	3.42E+00			2.06E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	26.00			26.00											
Average Repair Time (Min Qty, Max Qty)	6.84E+00			4.11E+01											
CV or beta (Min Qty, Max Qty)	0.44			0.38											
Quantity Unit:	LF 50			LF 50											
Environmental Impacts:	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta	Median Cost	Best Fit	CV or Beta
Embodied Carbon (kg CO2eq)	1.5E+01	LogNormal	0.44	8.5E+03	LogNormal	0.38									
Embodied Energy (MJ)	4.4E+02	LogNormal	0.44	2.6E+05	LogNormal	0.38									
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	YES			YES											
Casualty-affected Planar Area (sf) per Normative Unit:	By User			By User											
Serious Injury (Median, Dispersion)	By User	By User		By User	By User										
Loss of Life (Median, Dispersion)	By User	By User		By User	By User										
Post-event Tagging Flag:	By User			By User											
Unsafe Placard Trigger (Median, Dispersion)	By User	By User		By User	By User										

Comments:

None

Date Created:
Approved (YES / NO)?
Official (YES / NO) ?
Author:
Revisions:

Not Given
By User
By User
Not Given
None

Root Cost Multiplier: 50
Date Generated: 02/26/19