Earthquake Mitigation for Hospitals: Workshop

Part 9 – Nonstructural Equipment Mitigation
Nonstructural Mitigation Options

- Retrofit
- Replace
- Relocate
- Replicate (redundancy N+1/ provide a back-up)
- Plan for the consequences of failure
Nonstructural Resources

- FEMA 74 – Reducing the Risks of Nonstructural Earthquake Damage – A Practical Guide
- FEMA 154/155 – Rapid Visual Screening of Buildings for Potential Seismic Hazards
- ASCE/SEI 31-03 – Standard Seismic Evaluation of Existing Buildings
- ASCE 41-06 – Seismic Rehabilitation of Existing Buildings
Nonstructural Resources

- FEMA 412: Installing Seismic Restraints for Mechanical Equipment
- FEMA 413: Installing Seismic Restraints for Electrical Equipment
- FEMA 414: Installing Seismic Restraints for Duct and Pipe
Nonstructural Mitigation

Step 1 – Risk Assessment

Life Safety
Property Loss
Functional Loss
Life Safety

If item is damaged and inoperable will it:
• Become dislodged and hurt someone?
• Interrupt life support equipment?
• Harm patient’s health?
• Prevent ability to perform emergency room services? Operating room services? Other critical care services?
• Require patients to be transferred?
Can it hurt someone?
Can it hurt someone?
Can it interrupt life support?
Can it harm patient’s health?
Prevent ability to provide critical care services?
Require evacuation?
Nonstructural Mitigation

Step 1 – Risk Assessment

Life Safety

Property Loss

Functional Loss
Property Loss

Repair or replacement of:

- Equipment
- Interior finishes
- Exterior cladding
Nonstructural Mitigation

Step 1 – Risk Assessment

Life Safety

Property Loss

Functional Loss
Functional Loss

Earthquake Mitigation for Hospitals: Workshop
Nonstructural Mitigation Steps

1. Facility risk assessment:
   - Desk-top survey
   - Rapid visual survey of the facility
   - Comprehensive facility risk assessment of building and nonstructural components

2. Rank & prioritize risks

3. Develop a Mitigation Plan from the assessment findings and recommendations

4. Capitalize and begin to implement the Mitigation Plan
## FEMA 74 Nonstructural Assessment

### Nonstructural Inventory Survey Form

<table>
<thead>
<tr>
<th>Room ID</th>
<th>Element Description</th>
<th>Quantity</th>
<th>Units</th>
<th>Restraint Detail</th>
<th>Retrofit Required Y/N</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>501</td>
<td>Administrative Offices:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Suspended Ceiling</td>
<td>1</td>
<td>sq. ft.</td>
<td></td>
<td>Y</td>
<td>Attach perimeter grid to (2) adjacent walls.</td>
</tr>
<tr>
<td></td>
<td>2x4 Fluorescent Lights</td>
<td>6</td>
<td></td>
<td></td>
<td>Y</td>
<td>Add safety wires to lights – One each opposite corner.</td>
</tr>
<tr>
<td></td>
<td>Bookcases at exit</td>
<td>2</td>
<td></td>
<td></td>
<td>Y</td>
<td>Relocate bookcases from egress corridor, or anchor to adjacent wall studs per Detail ES-5.</td>
</tr>
<tr>
<td>502</td>
<td>Electrical Room:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dry-Type Transformer</td>
<td>1</td>
<td></td>
<td></td>
<td>Y</td>
<td>Anchor unanchored transformer.</td>
</tr>
<tr>
<td></td>
<td>Automatic Transfer Switch Panel</td>
<td>1</td>
<td></td>
<td></td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Telecom/Network Rack</td>
<td>2</td>
<td></td>
<td></td>
<td>N</td>
<td>Rack bases are well anchored.</td>
</tr>
<tr>
<td></td>
<td>Electric Bus Duct</td>
<td>1</td>
<td></td>
<td></td>
<td>N</td>
<td>Well braced top &amp; bottom.</td>
</tr>
</tbody>
</table>

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*Earthquake Hazard Mitigation for Nonstructural Elements*

*Nonstructural Inventory Survey Form*
Identifying Nonstructural Hazards

- Ceilings
- Lights
- Partitions
Identifying Nonstructural Hazards

- Nuclear medicine equipment
  - Suspended
  - Floor-mounted
- Ceilings
- Overhead lights
- Suspended piping
Identifying Nonstructural Hazards

- Ice Maker
- Med Stations
- Wall-mounted monitors
- Ceiling
- Overhead lights
- Suspended piping
Identifying Nonstructural Hazards

- Sterilizers
- Storage cabinets
- Mobile carts
- Casework
- Ceilings
- Overhead lights
- Suspended piping
Identifying Nonstructural Hazards

- Contents
- Storage racks
- Shelves
- Overhead lights
- Suspended piping
Identifying Nonstructural Hazards

- Refrigerators
- Analyzers
- Bench top equipment
- Storage cabinets
- Bookcases
- Ceilings
- Overhead lights
- Suspended piping
Identifying Nonstructural Hazards

- Cabinets
- Casework
- Ceiling
- Overhead lights
- Suspended piping
Identifying Nonstructural Hazards

- OR lights
- Equipment booms
- Film viewers
- Monitors
- Ceiling
- Suspended piping and HVAC
Identifying Nonstructural Hazards

- Monitors
- Headwall
- Casework
- Storage cabinets
- Televisions
- Ceiling
- Suspended piping
Identifying Nonstructural Hazards

- Radiology equipment
- Casework
- Storage cabinets
- Ceiling
- Suspended piping
Identifying Nonstructural Hazards

- Boilers
- Chillers
- Tanks
- Cooling Towers
- Air handlers
- Exhaust fans
- Fan coils
- Piping
- Ductwork
Identifying Nonstructural Hazards

- Generators
- Motor control equipment
- Switchgear
- Transformers
- Panel boards
- Conduit
- Bus duct
Identifying Nonstructural Hazards

- Continuous piping
- Continuous conduit
- Partitions

Building Separations
Identifying Nonstructural Hazards

- Cladding
- Parapets
- Glazing
- Signs
- Canopies
Mitigating Nonstructural Risks

- Building utility systems
- Architectural elements
- Medical equipment
- Furniture and contents
Emergency Generator

Anchor Bolt
Emergency Generator

Seismic Strengthening

Non-seismic isolators
Emergency Generator

Seismic chain restraints
Ups Battery Cabinet

Missing anchor
Seismic retrofit
Packaged Chiller Unit

Seismic Strengthening

Non-seismic base isolators
Instrument Air Compressor

Base Strengthening
Fuel Oil Storage Tank

Additional Base Strengthening
Fuel Oil Day Tank

Marginal strengthening measure using seismic strap. Note large gap at wall and absence of base anchorage.
Suspended Piping
Suspended Conduit
Gas Hot Water Heaters
Architectural Elements

Parapet bracing
Ceilings

- Compression post and splayed wire bracing
- Proper grid attachment at walls
Lights

Independent support at two diagonally opposite corners
Partitions

Added bracing at top of partial height studs
Demountable Partitions

TYPICAL WORKSTATION

IN LINE HINGE
(4) TOTAL PER BUTT JOINT
SEE DET. 3

90° HINGE (+) TOTAL PER CORNER JOINT
SEE DET. 4

DESK CONN. PL.
SEE DET. 2

ANCHOR PL.
SEE DET. 1
(2 TOT. PER PANEL)
Shelving
Cabinets
Refrigerators
Operating Room Lights
Operating Room Lights
Mobile Carts
Sterilizer
Sterilizer

Flexible connection in gas line
Televisions
Televisions
Televisions
Bench, Rack, or Table-Top Restraints
Bench, Rack, or Table-Top Restraints
Furniture/Shelving Content Restraints

- Small Equipment Base Anchorage
- Shelving Part Container Restraints
Furniture Restraints
Typical Product Restraints
Computer Equipment

Raised floor bracing
Equipment Anchorage
Implementation

Biggest challenges of nonstructural mitigation in a hospital:

1. 24/7
2. No swing space
3. Infection control
4. Hazardous materials
Patient Care Areas
Patient Care Areas
Patient Care Areas
Best Long Term Strategy

New Construction:
Do it right the first time

Remodel:
Take care of problems when you have the chance