

# FEMA Building Science Resources to Help Reduce Risk and Improve Resilience

DECEMBER 2018

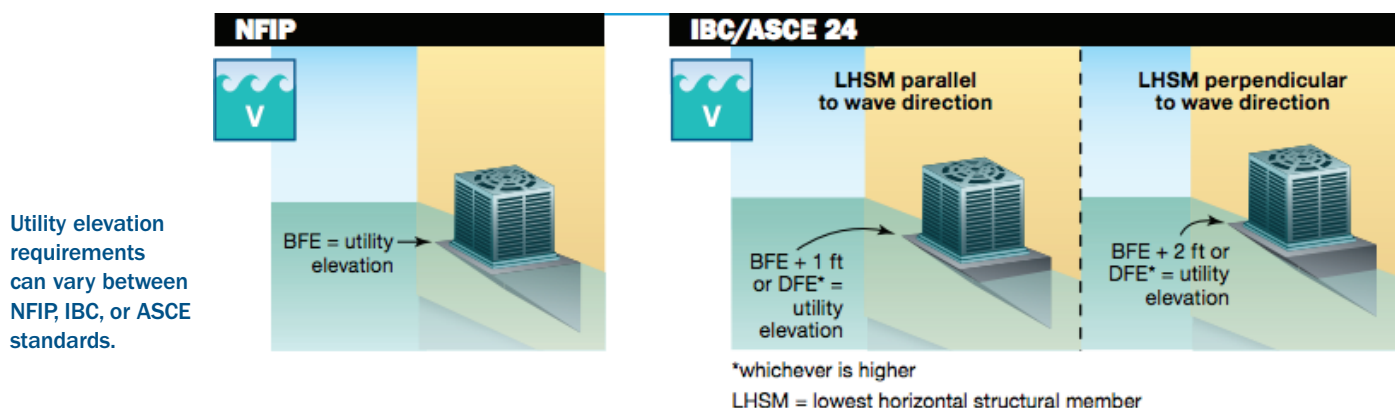
Before building in your community, it is important to consider the hazards that may be present, their potential impact, and how to mitigate the risk associated with those hazards. Effective design, construction, and enforcement, and building to or exceeding the latest standard of practice, increases the disaster resilience of structures and their associated utility systems exposed to risk, thereby reducing damages and injuries. The Federal Emergency Management Agency's (FEMA) Risk Mapping, Assessment, and Planning (Risk MAP) program uses precise flood mapping products, risk assessment tools, and planning outreach support to enhance a community's understanding of hazard mitigation and to encourage risk-informed decisions. Together, FEMA's Building Science Branch and Risk MAP program leverage insights about mitigation planning, risk reduction, and building design to create disaster-resilient communities that help reduce the loss of life and property.

Within the framework of Risk MAP, communities can use FEMA's Building Science resources to gain a better understanding of effective mitigation actions to consider for the design and construction of buildings and utility systems. Taking these actions could reduce vulnerability to hazards and increase resilience for property owners and other stakeholders, as well as their communities. Communities might be similar in some respects, but they are also unique in many ways. They may have different ordinances, requirements, hazards, vulnerabilities, risks, building stock, and location-specific attributes. For more information on how FEMA Building Science can help minimize natural hazard impacts to your community, reference the Region IV Fact Sheet 1 of 2 — *FEMA Building Science Considerations for Risk MAP*.

FEMA's Building Science publications and the additional resources included in this fact sheet provide insight and best practices for improving resilience. These resources can be found in FEMA P-787 [Catalog of FEMA Building Science Branch Publications and Training Courses](#) and can be used to help people better understand the disaster-resistant provisions of building codes and standards, as well as more effective ways to strengthen buildings. FEMA publications also offer examples of best practices that can be referenced for specific situations.

Each of the underlined titles has a hyperlink that enables the reader to click and view or download the resource. If the hyperlink does not work, please copy and paste the resource title into a search engine and try to find that resource manually.

**FLOOD RESOURCES:** Some buildings in a community, along with their utility systems, are prone to damage from flooding, including riverine or coastal events. However, proactive measures can help reduce their vulnerability to flood damage. The following resources and guidance documents provide a variety of measures that may apply to mitigating flood damage to buildings and their utility systems in your community. These downloadable resources developed by or through FEMA's Building Science Branch can be accessed at <https://www.fema.gov/building-code-resources>.



The following FEMA Building Science resources can help users better understand the flood-resistant provisions in Building Codes and Standards:

- [Flood Resistant Provisions of the 2018 International Codes](#)
- [Flood Resistant Provisions of the 2015 International Codes](#)
- [Flood Resistant Provisions of the 2012 International Codes](#)
- [Flood Resistant Provisions of the 2009 International Codes](#)
- [Summary of Changes from the 2006 to 2009 I-Codes](#)
- [NFIP – 2018 I-Codes and ASCE 24 Checklist](#)
- [NFIP – 2015 I-Codes and ASCE 24 Checklist](#)
- [NFIP – 2012 I-Codes and ASCE 24 Checklist](#)
- [Reducing Flood Losses Through the International Codes: 4th Ed; 2014](#)
- [Highlights of ASCE 24 Flood Resistant Design and Construction 24-14](#)
- [Highlights of ASCE 24 Flood Resistant Design and Construction 24-05](#)
- [Quick Reference Guide: Comparison of Select NFIP and Building Code Requirements for Special Flood Hazard Areas](#)
- [Quick Reference Guide: Comparison of Select NFIP & 2018 I-Code Requirements for Special Hazard Areas \(2018\)](#)

Numerous FEMA Building Science resources providing guidance on how to mitigate flood damage can be downloaded from <https://www.fema.gov/building-science-publications>. The following documents are some of the many publications developed to help stakeholders and property owners mitigate their flood risk:

#### FEMA PUBLICATIONS:

- FEMA P-499: [Home Builder's Guide to Coastal Construction](#)
- FEMA P-550: [Recommended Residential Construction for Coastal Areas](#)
- FEMA P-55 Volume I: [Coastal Construction Manual](#)
- FEMA P-85, Second Edition: [Protecting Manufactured Homes from Floods and Other Hazards](#)
- FEMA P-312, Third Edition: [Homeowner's Guide to Retrofitting: Six Ways to Protect Your Home From Flooding](#)
- FEMA P-348, Second Edition: [Protecting Building Utility Systems from Flood Damage](#)
- FEMA P-758: [Substantial Improvement/Substantial Damage Desk Reference](#)
- FEMA P-762: [Local Officials Guide for Coastal Construction: Design Considerations, Regulatory Guidance, and Best Practices for Coastal Communities](#)
- FEMA P-936: [Floodproofing Non-Residential Buildings](#)

## FEMA TECHNICAL BULLETINS:

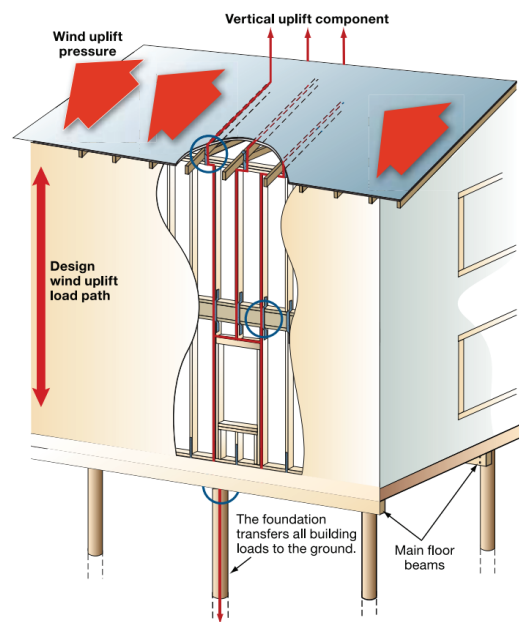
- [Technical Bulletin 0, User's Guide to NFIP Technical Bulletins \(2009\)](#)
- [Technical Bulletin 1, Openings in Foundation Walls and Walls of Enclosures \(2008\)](#)
- [Technical Bulletin 2, Flood Damage-Resistant Materials Requirements \(2008\)](#)
- [Technical Bulletin 3, Non-Residential Floodproofing-Requirements and Certification \(1993\)](#)
- [Technical Bulletin 4, Elevator Installation \(2010\)](#)
- [Technical Bulletin 5, Free-of-Obstruction Requirements \(2008\)](#)
- [Technical Bulletin 6, Below-Grade Parking Requirements \(1993\)](#)
- [Technical Bulletin 7, Wet Floodproofing Requirements \(1993\)](#)
- [Technical Bulletin 8, Corrosion Protection of Metal Connectors in Coastal Areas \(1996\)](#)
- [Technical Bulletin 9, Design and Construction Guidance for Breakaway Walls Below Elevated Coastal Buildings \(2008\)](#)
- [Technical Bulletin 10, Ensuring Structures Built on Fill In or Near Special Flood Hazard Areas are Reasonably Safe From Flooding \(2001\)](#)
- [Technical Bulletin 11, Crawlspace Construction for Buildings Located in Special Flood Hazard Areas \(2001\)](#)

**WIND RESOURCES:** Buildings in a community are often prone to wind damage from hurricanes, tornadoes, severe storms, or other wind events. However, proactive measures can be taken to reduce a structure's vulnerability to wind. The following FEMA Building Science resources and guidance documents provide a variety of measures that may be helpful in mitigating wind damage to buildings and their contents within your community.

Additional FEMA Building Science resources related to wind-resistant provisions in building codes and standards can be downloaded at <https://www.fema.gov/building-science> and include the following:

- [2015 International Building Code: A Compilation of Wind Resistant Provisions](#)
- [Highlights of ICC 500-2014, ICC/NSSA Standard for the Design and Construction of Storm Shelters](#)

Guidance resources to help mitigate wind damage can be downloaded from <https://www.fema.gov/building-science-publications> and some examples include the following:



An overview of potential loads and forces that can impact a structure.

## FEMA PUBLICATIONS:

- FEMA P-55 Volume 1: [Coastal Construction Manual](#)
- FEMA P-320, Fourth Edition: [Taking Shelter from the Storm: Building a Safe Room for Your Home or Small Business](#)
- FEMA P-361, Third Edition: [Safe Rooms for Tornadoes and Hurricanes](#)
- FEMA P-431, Second Edition: [Tornado Protection: Selecting Refuge Areas in Buildings](#)
- FEMA P-804: [Wind Retrofit Guide for Residential Buildings](#)
- FEMA P-499: [Home Builder's Guide to Coastal Construction](#)

## FEMA FACT SHEETS:

- [Foundation and Anchoring Criteria for Safe Rooms](#)

**MITIGATION ASSESSMENT TEAM:** The Mitigation Assessment Team (MAT) Program assesses and evaluates post-disaster building performance and develops recommendations to improve codes, standards, and materials; identifies gaps in knowledge, testing, and research; promotes best practices; and provides specific guidance to many different stakeholders. The following MAT reports, Recovery Advisories, and fact sheets provide conclusions and recommendations based on these observations that can help guide recovery and mitigation actions.

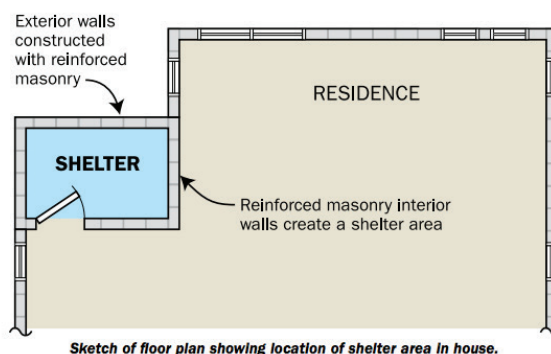
Only links to MAT reports developed after 2006 are listed below. Although numerous MAT reports on hazard events that occurred prior to 2006 are not listed, they can be downloaded from <https://www.fema.gov/fema-mitigation-assessment-team-mat-reports>. The Recovery Advisories and fact sheets can be accessed through this website as well.

### MAT REPORTS:

- [FEMA P-2021: Hurricanes Irma and Maria in the U.S. Virgin Islands \(2018\)](#)
- [FEMA P-1020 - Formal Observation Report - Tornado: Moore, Oklahoma, May 20, 2013 \(2014\)](#)
- [FEMA P-942 - Hurricane Sandy in New Jersey and New York \(2013\)](#)
- [FEMA P-938 - Hurricane Isaac in Louisiana \(2013\)](#)
- [FEMA P-908 - Spring 2011 Tornadoes: April 25-28 and May 22 \(2012\)](#)
- [Mississippi Tornado Outbreak, April 23rd-24th \(2010\)](#)
- [FEMA P-765 - Midwest Floods of 2008 in Iowa and Wisconsin \(2009\)](#)
- [FEMA P-757 - Hurricane Ike in Texas and Louisiana \(2009\)](#)
- MAT reports for Hurricanes Harvey, Irma, and Maria will be posted on [FEMA's MAT Reports website](#) when they become available.

### RECOVERY ADVISORIES (RAs):

- [Hurricanes Harvey, Irma and Maria \(2017\)](#): RAs provide information to assist with rebuilding decisions after the 2017 hurricane season as well as future high wind or flooding events
- [2016 Fall Flooding in Iowa \(2017\)](#): RAs 1-5 present mitigation measures that can and have been implemented to minimize damage to residential buildings and critical facilities subject to riverine flooding
- [Hurricane Sandy \(2013\)](#): RAs 1-7 assess the damages from Hurricane Sandy and provide guidance applicable to other hurricane-affected areas
- [Hurricane Isaac \(2012\)](#): RAs 1-2 offer mitigation measures that could be taken to minimize flood damage to buildings
- [2011 Tornadoes in Alabama, Mississippi, Tennessee, Georgia and Missouri](#): RAs 1-8 advise assessment and mitigation of tornado risk
- [2008 Midwest Floods in Iowa and Wisconsin \(2009\)](#): RAs 1-3 deal with design considerations for improving critical facility function during flood events, and considerations for rebuilding your flood-damaged house
- [Hurricane Ike \(2009\)](#): RAs 1-8 on methods of building to protect against high wind and flood
- [2007 Tornadoes in Kansas](#): RAs 1-3 on risks, hazards, storm shelters, and residential sheltering
- [2007 Tornadoes in Florida](#): RAs 1-5 on tornado risk, sheltering from tornadoes, and improving manufactured homes to resist damage from high winds





### FEMA FACT SHEETS:

- [Guidance for Applying ASCE 24 Engineering Standards to HMA Flood Retrofitting and Reconstruction Projects](#)
- [Mitigation Assessment Teams; Building Stronger and Safer](#)



### ADDITIONAL RESOURCES:

While wind and flooding are two of the most common hazards addressed by FEMA Building Science, resources are available for mitigation of other hazards as well. Now in its fifth edition, [FEMA P-787, Catalog of FEMA Building Science Publications and Training Courses \(2016\)](#) includes descriptions of available FEMA publications, training courses, and workshops for natural hazards. To receive further assistance, contact the Building Science Helpline at 866-927-2104.

FEMA Building Science continually improves its understanding of the built environment and revises publications and resources based on lessons learned from post-disaster field assessments through MATs or by incorporating lessons from research performed by universities or other organizations, updates to codes and standards, and changes by the design and construction industry. Please continue to check FEMA Building Science resources to take advantage of the revisions and additions to the ever-growing library or subscribe to receive future email updates.

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**FOR ADDITIONAL FEMA BUILDING SCIENCE INFORMATION, OR TO ASK QUESTIONS, PLEASE CONTACT ANY OF THE FOLLOWING RESOURCES:**

#### **THE FEMA BUILDING SCIENCE HELPLINE**

FEMA-BuildingScienceHelp@fema.dhs.gov  
(Office) 866-927-2104

#### **FEMA REGION IV MITIGATION DIVISION RISK ANALYSIS (RA) BRANCH BUILDING SCIENCE PERSONNEL**

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