

# FEMA Building Science Resources to Assist with Reconstruction after a Hurricane



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FEMA has produced numerous publications detailing best practices for natural hazard mitigation associated with hurricane impacts. This flyer summarizes a few of the readily available publications and resources that can be used by homeowners as well as design and construction professionals during reconstruction following hurricanes.

## Recovery Advisories

After major disasters, FEMA's Mitigation Assessment Teams (MATs) often conduct forensic investigations of building performance and publish the results in various publications. One subset of these publications is Recovery Advisories, which present guidance on design, construction, and restoration of buildings in areas subject to the effects of the particular disaster. MATs have published Recovery Advisories for Hurricanes Charley, Ivan, Katrina, Ike, Isaac, and Sandy. Some of the titles are *Initial Restoration for Flooded Buildings*, *The ABC's of Returning to Flooded Buildings*, *Designing for Flood Levels Above the BFE*, *Siding Installation in High-Wind Regions*, and *Asphalt Shingle Roofing for High-Wind Regions*. All Recovery Advisories are available at <https://www.fema.gov/th/media-library/collections/24>.

### Improving Connections in Elevated Coastal Residential Buildings



**HURRICANE SANDY RECOVERY ADVISORY**  
EAL February 2013

**Purpose and Intended Audience**  
FEMA post-disaster assessments have identified residential buildings damaged during Hurricane Sandy that had inadequate connections between the elevated floor and the pile foundation (Figure 1). This Recovery Advisory provides best practices for improving connections between floors and pile foundations. The intended connection details apply to buildings with elevated floors that are greater than the base flood elevation (BFE). Even smaller elevated floors may experience an event greater than the base flood. The improved connection details presented in this advisory will provide added resistance against flood-related structural failure in the event the flood levels exceed the elevated height of the floor. Readers of this Recovery Advisory should consult FEMA's *Asphalt Shingle Roofing for High-Wind Regions* and *Designing for Flood Levels Above the BFE* for information on properly connecting buildings.

**Key Notes:**

1. Inadequate connections between structural building elements can lead to failure during a flood or high-wind event.
2. The connection between an elevated floor and a pile foundation must be designed to resist both uplift and shear loads (Figure 2).
3. Connections for elevated floors to pile foundation elements may differ from that used for other types of foundations. Connections should be inspected regularly and repaired as needed.

**Figure 1: Building with insufficient connections that caused failure of pile foundation when elevated floor pile attachment failed. Shingle connections were used on the floor to the foundation (Utility Block, 6/1).**

**Figure 2: Example load path through a floor-to-pile foundation connection.**

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## Technical Bulletins

provide guidance on complying with the minimum building performance requirements of the National Flood Insurance Program (NFIP). NFIP regulations are contained in Title 44 of the Code of Federal Regulations Section 60.3. FEMA has published 11 Technical Bulletins, and titles include *Openings in Foundation Walls and Walls of Enclosures*, *Non-Residential Floodproofing Requirements*, and *Certifications to Free-of-Obstruction Requirements*. All Technical Bulletins are available at <https://www.fema.gov/th/media-library/collections/4>.



### User's Guide to Technical Bulletins

Developed in accordance with the National Flood Insurance Program  
Technical Bulletin 0 / March 2009



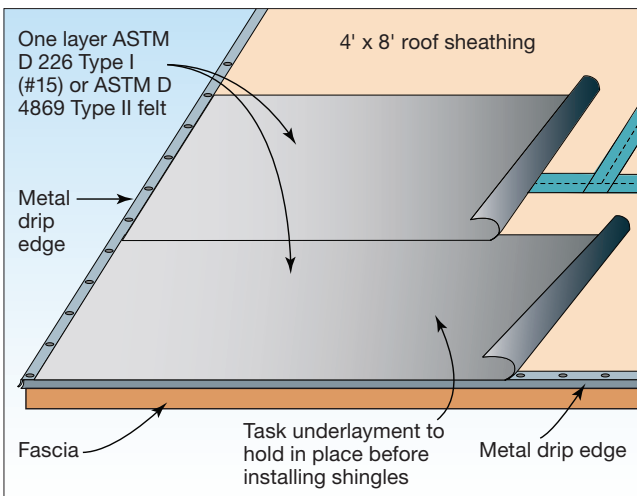
### Home Builder's Guide to Coastal Construction

Technical Fact Sheet Series  
FEMA P-499 / December 2010

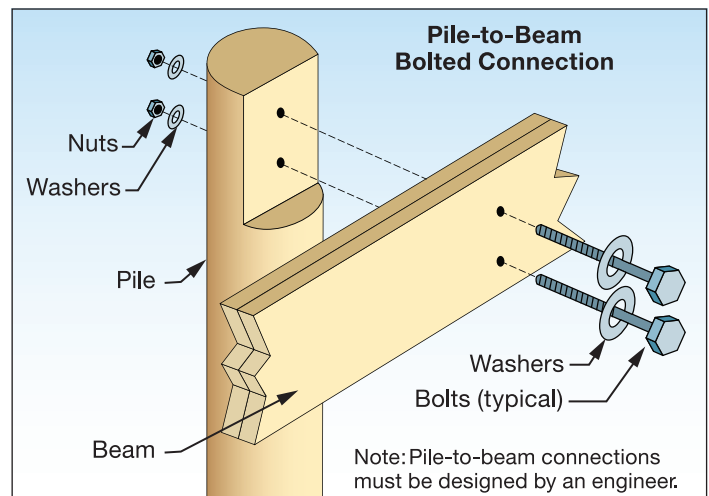


## FEMA P-499, Home Builder's Guide to Coastal Construction Fact Sheets

provides technical guidance on constructing residential buildings in coastal environments. The information is aimed at improving building performance in coastal areas that are subject to flood and wind forces. The 37 fact sheets contain information on planning, foundations, load paths, wall systems, openings, roofing, attachments, and repairs. FEMA P-499 is available at <https://www.fema.gov/media-library/assets/documents/6131>.



(Source: FEMA 499, Fact Sheet 7.2, Figure 3)



(Source: FEMA 499, Fact Sheet 3.3, Figure 1)

**FEMA P-312, *Homeowner's Guide to Retrofitting: Six Ways to Protect Your Home from Flooding***, is a guide for homeowners who want to know how to protect their homes from flooding. The guide provides clear information and straightforward guidance about flood mitigation options. Floodproofing methods are explained, including how they meet particular needs. The guide is written for people with little or no experience in flood protection or construction. FEMA P-312 is available at <https://www.fema.gov/media-library/assets/documents/480>.



## Protecting Building Utility Systems From Flood Damage

Principles and Practices for the Design and Construction of Flood Resistant Building Utility Systems

FEMA P-348, Edition 2 / February 2017



**FEMA P-348, *Protecting Building Utilities from Flood Damage***, contains the design and construction requirements for utility systems in residential and non-residential structures in flood-prone areas that must be met to comply with NFIP floodplain management requirements. The publication provides guidance on designing and constructing building utility systems so that the buildings are fully operational and can be re-occupied as soon as electricity, sewer, and water have been restored. FEMA P-348 is available at <https://www.fema.gov/media-library/assets/documents/3729>.

## Other Resources

FEMA's Building Science Branch has produced numerous publications on the impacts of hurricanes – including coastal foundation design and construction, retrofitting residential buildings for wind hazards, and a design guide for critical facilities prone to hurricanes. The list of publications is available in the FEMA P-787, *Catalog of FEMA Building Science Branch Publications and Training Courses* (<https://www.fema.gov/media-library/assets/documents/12909>). The Building Science Branch website (<http://www.fema.gov/building-science>) has links to additional resources for homeowners, local and government officials, engineers, and designers. Notable resources are the Substantial Damage Estimator software, *Protecting Your Property or Business from Flooding* and *Protecting Your Property or Business from High Winds* (<http://www.fema.gov/protect-your-property-or-business-disaster>), and FEMA's *Quick Reference Guide: Comparison of Select NFIP and Building Code Requirements for Special Flood Hazard Areas*. This guide highlights the similarities and the differences between NFIP minimum requirements and the requirements of the International Codes and American Society of Civil Engineers. These resources are available through the FEMA Resource and Document Library at <https://www.fema.gov/resource-document-library>. FEMA also has building code resources that include *Flood Resistant and Wind Provisions of the International Code Series*, *Highlights of ASCE 24 Flood Resistant Design and Construction*, and *Reducing Flood Losses Through the International Codes*. The FEMA building code resources can be found at <https://www.fema.gov/building-code-resources>.

**For more information**, see the FEMA Building Science Frequently Asked Questions website at <https://www.fema.gov/frequently-asked-questions-building-science>.

If you have any additional questions on FEMA Building Science Publications, contact the helpline at [FEMA-Buildingsciencehelp@fema.dhs.gov](mailto:FEMA-Buildingsciencehelp@fema.dhs.gov) or 866-927-2104.

You may also subscribe to the FEMA Building Science e-mail list serve, which is updated with publication releases and FEMA Building Science activities. Subscribe at [https://public.govdelivery.com/accounts/USDHSFEMA/subscriber/new?topic\\_id=USDHSFEMA\\_193](https://public.govdelivery.com/accounts/USDHSFEMA/subscriber/new?topic_id=USDHSFEMA_193).

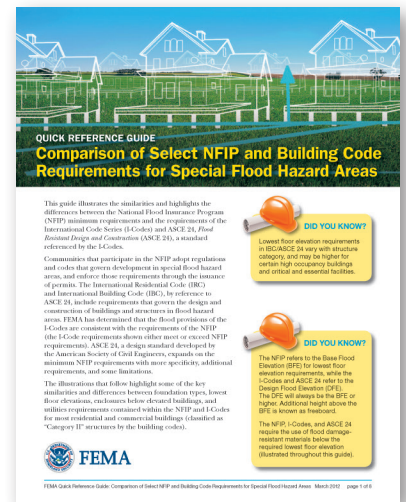
Visit the Building Science Branch of the Risk Management Directorate at FEMA's Federal Insurance and Mitigation Administration at <http://www.fema.gov/building-science>.



## Homeowner's Guide to Retrofitting

Six Ways to Protect Your Home from Flooding

FEMA P-312, 3<sup>rd</sup> Edition / June 2014



To order publications, contact the FEMA Distribution Center:

Call: 1-800-480-2520  
(Monday–Friday, 8 a.m.–5 p.m., EST)

Fax: 240-699-0525

E-mail: [FEMA-Publications-Warehouse@fema.dhs.gov](mailto:FEMA-Publications-Warehouse@fema.dhs.gov).

Additional FEMA documents can be found in the FEMA Library at <https://www.fema.gov/resource-document-library>.

Please scan this QR code to visit the FEMA Building Science web page.

