



User's Guide to Technical Bulletins

Developed in Accordance
with the National Flood Insurance Program

NFIP Technical Bulletin 0 / January 2021



FEMA

Comments on the Technical Bulletins should be directed to:

Department of Homeland Security / Federal Emergency Management Agency
Federal Insurance and Mitigation Administration (FIMA) Risk Management Directorate
Building Science Branch
400 C Street, S.W., Sixth Floor
Washington, DC 20472-3020

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Acronyms

ACI	American Concrete Institute
BFE	base flood elevation
CFR	Code of Federal Regulations
DFE	design flood elevation
FEMA	Federal Emergency Management Agency
FHBM	Flood Hazard Boundary Map
FIMA	Federal Insurance and Mitigation Administration
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
IBC®	International Building Code®
ICC®	International Code Council®
I-Codes®	International Codes®
IRC®	International Residential Code®
NFIP	National Flood Insurance Program
ORNL	Oak Ridge National Laboratory
SEI	Structural Engineers Institute
SFHA	Special Flood Hazard Area
TB	Technical Bulletin

1 Introduction and Background

Beginning in the early 1990s, the Federal Insurance and Mitigation Administration of FEMA has issued 11 Technical Bulletins that provide guidance on interpreting, enforcing, and complying with the minimum building performance requirements in the National Flood Insurance Program (NFIP) regulations (Title 44 of the Code of Federal Regulations [CFR] Parts 59 and 60). These requirements are intended to reduce the loss of life and property as well as the economic and social hardships that can result from flooding.

The NFIP is a federal program established by the National Flood Insurance Act of 1968, as amended (42 U.S. Code §§ 4011 et seq.). The primary purposes of the Act are to:

- Better indemnify individuals for flood losses through insurance
- Reduce future flood damage through state and community floodplain management regulations
- Reduce federal expenditures for disaster assistance and flood control

To participate in the NFIP, communities must adopt and enforce floodplain management regulations that meet or exceed NFIP floodplain management requirements. Owners of property located in communities that participate can purchase NFIP flood insurance as a protection against the financial impact of flood losses.

NFIP REQUIREMENTS AND HIGHER REGULATORY STANDARDS

State or Local Requirements. State or local requirements that are more restrictive or stringent than the minimum requirements of the NFIP take precedence. The Technical Bulletins and other FEMA publications provide guidance on the minimum requirements of the NFIP and describe best practices. Design professionals, builders, and property owners should contact local officials to determine whether more restrictive provisions apply to buildings or sites in question. All other applicable requirements of the state or local building codes must also be met.

Substantial Improvement and Substantial Damage. As part of issuing permits, local officials must review not only proposals for new construction but also for work on existing buildings to determine whether the work constitutes Substantial Improvement or repair of Substantial Damage. If the work is determined to constitute Substantial Improvement or repair of Substantial Damage, the buildings must be brought into compliance with the NFIP requirements for new construction. Some communities modify the definitions of Substantial Improvement and/or Substantial Damage to be more restrictive than the NFIP minimum requirements. For more information on Substantial Improvement and Substantial Damage, see FEMA P-758, *Substantial Improvement/Substantial Damage Desk Reference* (2010), and FEMA 213, *Answers to Questions About Substantially Improved/Substantially Damaged Buildings* (2018).

Higher Building Elevation Requirements. Some states and communities require that buildings be elevated or dry floodproofed (non-residential in Zone A only) above the NFIP minimum requirement. The additional elevation is called freeboard. Design professionals, builders, and property owners should check with local officials to determine whether a state or community has freeboard requirements. References to building elevations in this Technical Bulletin should be construed as references to the community's elevation requirement in areas where freeboard is required.

The NFIP floodplain management regulations, codified in Title 44 of the Code of Federal Regulations (CFR) Part 60, specifically 44 CFR § 60.3, include minimum building performance criteria that apply to (1) new construction, (2) work determined to be Substantial Improvement such as improvements, alterations, and additions, and (3) the repair of buildings determined to have incurred Substantial Damage and that are in Special Flood Hazard Areas (SFHAs).

1.1 Intended Audience

The Technical Bulletins are intended for use primarily by state and local officials who are responsible for interpreting and enforcing the NFIP floodplain management regulations.

The Technical Bulletins may also be used by design professionals (e.g., architects, engineers), contractors, building owners and operators, planners, and other interested stakeholders to help understand and comply with NFIP floodplain management requirements. Using the information in the Technical Bulletins will improve the design and construction of buildings, including their utility systems, that are in floodprone areas, thereby reducing the potential for damage and increasing building and community resilience.

1.2 Purpose of Technical Bulletins

The Technical Bulletins provide specific FEMA guidance for state and local floodplain management officials on complying with the NFIP’s minimum floodplain management criteria. While the primary focus of the Technical Bulletins is on how to meet the minimum NFIP floodplain management requirements, they also include information on:

- Recommended best practices for reducing flood losses
- Considerations related to NFIP flood insurance rates
- Building codes and standards

Additional information on how to use the Technical Bulletins is provided in Section 2.

TECHNICAL BULLETINS AND FLOODPLAIN MANAGEMENT BULLETINS

The NFIP Technical Bulletins provide guidance on complying with the minimum NFIP floodplain management requirements that apply to buildings. FEMA’s Floodplain Management Bulletins provide guidance on administering the NFIP requirements that apply to development other than buildings and guidance on some building requirements. The Floodplain Management Bulletins are available at <https://www.fema.gov/floodplain-management>.

1.3 Synopses of Technical Bulletins (as of January 2021)

Table 1: Technical Bulletin Synopses

TB No.	Title (Date)	Synopsis
0	<i>User’s Guide to Technical Bulletins (2021)</i>	Introduction and background for the TBs, including the intended audience, purpose, and synopses of available TBs; how to use the TBs; crosswalk of NFIP regulations and the TBs; key concepts and requirements used in the TBs; key terms and useful resources; supplemental information, including how to obtain copies of the TBs; FEMA Headquarters and Regional Office locations; and a key word/subject index for the TBs.

Table 1: Technical Bulletin Synopses (cont.)

TB No.	Title (Date)	Synopsis
1	<i>Requirements for Flood Openings in Foundation Walls and Walls of Enclosures Below Elevated Buildings in Special Flood Hazard Areas (2020)</i>	Guidance on the NFIP requirements for flood openings in foundation walls and walls of enclosures below elevated buildings in Zones A, AE, A1-30, AR, AO, and AH, with clarifications for use of non-engineered and engineered openings.
2	<i>Flood Damage-Resistant Materials Requirements for Buildings Located in Special Flood Hazard Areas (2008)</i>	Guidance on the NFIP requirements on the use of flood damage-resistant construction materials in building components below the BFE in SFHAs (both Zones A and V).
3	<i>Requirements for the Design and Certification of Dry Floodproofed Non-Residential and Mixed-Use Buildings Located in Special Flood Hazard Areas (2021)</i>	Guidance on the NFIP requirements for the design and certification of dry floodproofing systems for new and substantially improved non-residential and mixed-use buildings with lowest floors below the BFE in Zones A, AE, A1-30, AR, AO, and AH. The guidance can also be used as a best practice for improving the flood resilience of existing buildings that are not substantially improved. New in the 2020 edition are appendices with guidance for completing FEMA Form 086-0-34, NFIP Floodproofing Certificate for Non-Residential Structures, and an example calculation for estimating total seepage. FEMA Form 086-0-34 is used to satisfy the requirement for design professionals to certify designs and as-built drawings and inspection and is a requirement for an NFIP flood insurance policy. The total seepage estimation is used to determine if dry floodproofing measures are considered substantially impermeable to floodwaters.
4	<i>Elevator Installation for Buildings Located in Special Flood Hazard Areas (2019)</i>	Guidance on the NFIP requirements for elevator machinery and equipment that serve buildings and on the installation of elevators below the Base Flood Elevation (BFE) in Special Flood Hazard Areas (SFHAs) (both Zones A and V).
5	<i>Free-of-Obstruction Requirements for Buildings Located in Coastal High Hazard Areas (2020)</i>	Guidance on NFIP requirements concerning obstructions to floodwaters and waves beneath and associated with elevated buildings in Coastal High Hazard Areas (Zones V, VE, V1-30, and VO). Obstructions can include portions of elevated buildings and building site modifications.
6	<i>Requirements for Dry Floodproofed Below-Grade Parking Areas Under Non-Residential and Mixed-Use Buildings Located in Special Flood Hazard Areas (2021)</i>	Guidance on the NFIP requirements for the design and construction of dry floodproofing systems below-grade parking area under new and substantially improved non-residential and mixed-use buildings located in Zones A, AE, A1-30, AR, AO, and AH. Used in conjunction with TB 3 to highlight issues specific to dry floodproofed below-grade parking areas.
7	<i>Wet Floodproofing Requirements for Structures Located in Special Flood Hazard Areas (1993)</i>	Guidance on the NFIP requirements concerning measures referred to as “wet floodproofing” applied to certain types of structures in Zones A, AE, A1-30, AR, AO, and AH.
8	<i>Corrosion Protection for Metal Connectors and Fasteners in Coastal Areas (2019)</i>	Why maintaining the load paths in buildings is important and the important role that the proper corrosion protection of metal connectors and fasteners has in ensuring that buildings in coastal areas are adequately anchored and connected to resist floods and high wind events.

Table 1: Technical Bulletin Synopses (cont.)

TB No.	Title (Date)	Synopsis
9	<i>Design and Construction Guidance for Breakaway Walls Below Elevated Buildings Located in Coastal High Hazard Areas (2008)</i>	Prescriptive, simplified, and performance-based design approaches to meeting NFIP requirements in the design and construction of wood-framed breakaway walls beneath elevated buildings in Coastal High Hazard Areas (Zones V, VE, and V1-30).
10	<i>Ensuring That Structures Built on Fill In or Near Special Flood Hazard Areas Are Reasonably Safe From Flooding (2001)</i>	Regulatory and technical guidance on ensuring that the construction of the following buildings are reasonably safe from flooding; buildings with various types of foundations, including basements, in areas that have been proposed to be removed from the SFHA through the placement of fill and in areas near the SFHA.
11	<i>Crawlspace Construction for Buildings Located in Special Flood Hazard Areas (2001)</i>	Interim guidance on minimum NFIP requirements for below-grade crawlspace construction that may extend 1 or 2 feet below grade.

BFE = base flood elevation
 FEMA = Federal Emergency Management Agency
 NFIP = National Flood Insurance Program
 SFHA = Special Flood Hazard Area
 TB = Technical Bulletin

1.4 Organization of Technical Bulletin 0 – User’s Guide to Technical Bulletins

This User’s Guide to Technical Bulletins contains:

- Information on how to use the Technical Bulletins
- Crosswalk of the NFIP regulations and the Technical Bulletins
- Key concepts and requirements in the Technical Bulletins
- Glossary of acronyms and key terms
- How to obtain copies of Technical Bulletins and submit comments
- FEMA Headquarters and Regional office contact information
- Index of key words and subjects in the Technical Bulletins
- References and resources

2 How to Use the Technical Bulletins

FEMA revises or develops new Technical Bulletins as needed to provide guidance to state and local officials, design professionals, contractors, building owners and operators, planners, and other interested stakeholders to help them comply with NFIP floodplain management requirements.

The Technical Bulletins are focused on minimum NFIP floodplain management criteria. They also provide guidance on best practices for floodplain management and flood hazard-resistant construction, building codes and standards, and NFIP flood insurance considerations.

2.1 Minimum NFIP Floodplain Management Criteria

To participate in the National Flood Insurance Program, communities must adopt regulations that meet or exceed the minimum requirements in 44 CFR § 60.3. The Technical Bulletins provide specific FEMA guidance on complying with minimum NFIP floodplain management requirements. If a community chooses not to use the methods or implement the measures that are described in the Technical Bulletins, the community must demonstrate how it is meeting the requirements of 44 CFR § 60.3.

In addition to the community's responsibility to ensure specific building requirements are met, such as elevating or dry floodproofing buildings, elevating or otherwise protecting utilities, and installing openings in enclosure walls, communities are also required to review development proposals "to determine whether such proposals will be reasonably safe from flooding" (44 CFR § 60.3(a)(4)).

To participate in the NFIP, all communities must adopt a resolution or ordinance that expresses a "commitment to recognize and evaluate flood hazards in all official actions and to take such other official action as reasonably necessary to carry out the objectives of the program" (44 CFR § 59.22(a)(8)). This is in addition to the general requirement that communities "take into account flood hazards to the extent that they are known in all official actions relating to land management and use" (44 CFR § 60.1(c)).

2.2 Best Practices

Some of the best practices for floodplain management and flood hazard-resistant construction that are described in the Technical Bulletins are recommendations for increasing hazard resistance in buildings and their utility systems and for reducing the loss of life and property and economic and social hardships.

FEMA strongly encourages that these best practices be:

- Incorporated into state or community floodplain management ordinances or building codes

MINIMUM FLOODPLAIN MANAGEMENT CRITERIA

The guidance in the Technical Bulletins represents established, application methodologies for minimum NFIP floodplain management criteria.

REASONABLY SAFE FROM FLOODING

The Technical Bulletins can be used by communities to help them evaluate whether proposed development will be reasonably safe from flooding.

COMMUNITY COMMITMENT TO REDUCING FLOOD LOSSES

Using the guidance in the Technical Bulletins illustrates a community's commitment towards evaluating and addressing flood hazards.

USE OF SHALL OR MUST

"Shall" or "must" in the Technical Bulletins indicates official guidance on methods or measures required for compliance with 44 CFR § 60.3. Descriptions of other measures, such as best practices, do not use "shall" or "must." FEMA strongly encourages that best practice measures be considered.

- Implemented by designers, builders, or other stakeholders to reduce risk and improve resilience
- Used to potentially lower NFIP flood insurance premiums

Many of these best practices are based on field-verified data including data from decades of post-disaster building performance assessments.

**EXAMPLE OF A BEST PRACTICE FROM TECHNICAL BULLETIN 2,
FLOOD DAMAGE-RESISTANT MATERIALS REQUIREMENTS**

If the lowest floor of a building is elevated higher than the BFE, which is common when the owner wants a full story of elevation to accommodate parking under the building, FEMA recommends that flood damage-resistant materials also be used up to the level of the lowest floor to reduce damage in these areas should flooding exceed the BFE.

2.3 Building Codes and Standards

In addition to complying with the NFIP requirements, all new construction, Substantial Improvements, and repair of Substantial Damage must comply with the applicable building codes and standards that have been adopted and that are enforced by states and communities. Building codes govern the design, construction, alteration, and maintenance of structures. They specify the minimum requirements to adequately safeguard the health, safety, and welfare of building occupants. Rather than create and maintain their own building codes, most states and local jurisdictions adopt the International Codes® (I-Codes®), which are a family of model building codes published by the International Code Council® (ICC®).

I-Codes include the International Residential Code® (IRC®), International Building Code® (IBC®), International Existing Building Code® (IEBC®), and codes that govern the installation of mechanical, plumbing, fuel gas service, and other aspects of building construction. Provisions in state- and community-adopted building codes can vary from these model codes, so coordination with local building officials is necessary to confirm which requirements apply within a given jurisdiction.

The IBC applies to all applicable buildings and structures whereas the scope of the IRC is limited to one- and two-family dwellings and townhomes not more than three stories above grade plane. The IBC can be used to design dwellings, but it is used primarily for buildings and structures other than dwellings within the IRC scope. The flood provisions in the IBC are included by reference to ASCE 24, *Flood Resistant Design and Construction*, a standard developed by the American Society of Civil Engineers (ASCE).

FEMA has deemed that the latest published editions of the I-Codes generally meet or exceed NFIP requirements for buildings and structures. Excerpts of the flood provisions of the I-Codes are available on FEMA's

**BUILDING CODES AND
STANDARDS COMPARISON
WITH NFIP REQUIREMENTS**

Each Technical Bulletin provides a comparison of the building codes and standards that are related to the Technical Bulletin's topic and the NFIP requirements. The comparison indicates the aspects of the codes/standards and the NFIP requirements that are equivalent and the aspects of the codes/standards that exceed the NFIP requirements.

**BUILDING CODE ADOPTION
AND ENFORCEMENT**

Building codes are only enforceable if adopted by the State or community but can serve as best practices in communities that have not adopted codes.

Building Science – Flood Publications webpage (<https://www.fema.gov/emergency-managers/risk-management/building-science/flood>).

The joint ICC and FEMA publication *Reducing Flood Losses Through the International Codes: Coordinating Building Codes and Floodplain Management Regulations, 5th Edition* (2019) recommends that communities coordinate the administration of floodplain management provisions and building codes. Differences in requirements between the regulatory tools can lead to inconsistencies or confusion when administering and enforcing requirements for development in floodprone areas.

2.4 NFIP Flood Insurance Considerations

Each Technical Bulletin addresses NFIP flood insurance considerations related to the topic of the Technical Bulletin. The following stakeholders should be aware of these considerations:

- Local officials, designers, builders, and other stakeholders
- Property owners who are concerned about the impact of design and construction decisions on their NFIP flood insurance premiums

NFIP flood insurance premiums are based on factors that include, but are not limited to, flood risk zone, elevation of the lowest floor above or below the BFE, type of building and foundation, the number of floors, and whether there is a basement or enclosure below the elevated building.

The Technical Bulletins address situations in which a compliant building might still be subject to higher NFIP flood insurance premiums. As only one example, NFIP Technical Bulletin 3, *Requirements for the Design and Certification of Dry Floodproofed Non-Residential and Mixed-Use Buildings Located in Special Flood Hazard*

Areas, notes that the minimum NFIP requirements allow a new or Substantially Improved non-residential building in Zone A to have a lowest floor below the base flood elevation (BFE), provided that the building has been designed, constructed, and certified to be floodproofed to the BFE and meets established criteria. However, the NFIP flood insurance rating procedures provide credit for dry floodproofing only if the dry floodproofing measures are certified to be at least 1 foot above the BFE, even if that level of protection is not required by local floodplain management regulations.

NFIP FLOOD INSURANCE

The Technical Bulletins describe how NFIP flood insurance premiums can be affected by changes in design and construction. For example, some best practices can significantly lower annual NFIP flood insurance premiums.

3 Crosswalk of NFIP Regulations and Technical Bulletins

Table 2 is a crosswalk of select NFIP regulations and the Technical Bulletins that provide guidance on them. The table is intended to be a general guide to the Technical Bulletins; it does not include all of the NFIP regulations. See the index in Section 7 for more information on where to find guidance in the Technical Bulletins on specific NFIP regulations.

Table 2: Crosswalk of NFIP Regulations, Technical Bulletins, and Key Concepts

NFIP Regulation	Technical Bulletin Relevant to the NFIP Regulation	Key Concepts in the NFIP Regulations Covered in the Technical Bulletins
<p>44 CFR § 60.3(a)(3) Review all permit applications to determine whether proposed building sites will be reasonably safe from flooding. If a proposed building site is in a flood-prone area, all new construction and substantial improvements shall (i) be designed (or modified) and adequately anchored to prevent flotation, collapse, or lateral movement of the structure resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy, (ii) be constructed with materials resistant to flood damage, (iii) be constructed by methods and practices that minimize flood damages, and (iv) be constructed with electrical, heating, ventilation, plumbing, and air conditioning equipment and other service facilities that are designed and/or located so as to prevent water from entering or accumulating within the components during conditions of flooding.</p>	<p>Technical Bulletin 1 <i>Requirements for Flood Openings in Foundation Walls and Walls of Enclosures Below Elevated Buildings in Special Flood Hazard Areas</i></p>	<p>Flood openings in foundation walls and walls of enclosures relieve hydrostatic loads, helping to meet the basic performance requirement to prevent flotation, collapse, or lateral movement due to flood forces.</p>
	<p>Technical Bulletin 2 <i>Flood Damage-Resistant Materials Requirements for Buildings Located in Special Flood Hazard Areas</i></p>	<p>Typical construction materials are classified as acceptable or unacceptable for use below the BFE. Using acceptable materials improves resistance to flood damage.</p>
	<p>Technical Bulletin 3 <i>Requirements for the Design and Certification of Dry Floodproofed Non-Residential and Mixed-Use Buildings Located in Special Flood Hazard Areas</i></p>	<p>When designed to account for flood loads at the flood protection level, dry floodproofed non-residential and the non-residential portions of mixed-use buildings meet the basic performance requirement to be constructed using methods and practices that minimize flood damage.</p>
	<p>Technical Bulletin 4 <i>Elevator Installation for Buildings Located in Special Flood Hazard Areas</i></p>	<p>Installing elevators and associated equipment above the BFE prevents water from entering or accumulating within most elevator components during conditions of flooding.</p>
	<p>Technical Bulletin 5 <i>Free-of-Obstruction Requirements for Buildings Located in Coastal High Hazard Areas</i></p>	<p>Obstructions that divert or obstruct the free flow of floodwater and waves below elevated buildings in Zone V could impose additional flood loads on foundation systems or adjacent buildings.</p>
	<p>Technical Bulletin 6 <i>Requirements for Dry Floodproofed Below-Grade Parking Areas Under Non-Residential and Mixed-Use Buildings Located in Special Flood Hazard Areas</i></p>	<p>Non-residential and mixed-use buildings in Zone A may have dry floodproofed, below-grade parking areas, provided the buildings and garages are designed to account for flood loads and meet the basic performance requirement to be constructed using methods and practices that minimize flood damage.</p>
	<p>Technical Bulletin 7 <i>Wet Floodproofing Requirements for Structures Located in Special Flood Hazard Areas</i></p>	<p>Measures known as “wet floodproofing” may be used for specific types of buildings, including detached garages, storage buildings, some agricultural buildings, and buildings that meet the definition for functionally dependent use. Wet floodproofing reduces hydrostatic loads on buildings by allowing floodwater to enter.</p>

Table 2: Crosswalk of NFIP Regulations, Technical Bulletins, and Key Concepts (cont.)

NFIP Regulation	Technical Bulletin Relevant to the NFIP Regulation	Key Concepts in the NFIP Regulations Covered in the Technical Bulletins
<p>44 CFR § 60.3(a)(3) (cont.)</p>	<p>Technical Bulletin 8 <i>Corrosion Protection for Metal Connectors and Fasteners in Coastal Areas</i></p>	<p>Corrosion protection for metal fasteners and connectors in buildings in coastal areas is important in helping to ensure that the buildings are adequately anchored and connected to resist flood loads. In buildings that are exposed to moisture and airborne salt, protecting metal connectors and fasteners from corrosion helps prevent structural failure.</p>
	<p>Technical Bulletin 9 <i>Design and Construction Guidance for Breakaway Walls Below Elevated Buildings Located in Coastal High Hazard Areas</i></p>	<p>Walls designed to break away under flood loads help to prevent the walls from obstructing the floodwater and to minimize the transfer of flood and wave loads to the foundations of elevated buildings.</p>
	<p>Technical Bulletin 10 <i>Ensuring That Structures Built on Fill In or Near Special Flood Hazard Areas Are Reasonably Safe From Flooding</i></p>	<p>Residual flood hazards may exist on sites proposed to be modified by placement of compacted earthen fill material and are subject to the requirement to be reasonably safe from flooding.</p>
	<p>Technical Bulletin 11 <i>Crawlspace Construction for Buildings Located in Special Flood Hazard Areas</i></p>	<p>The ground or floor inside certain crawlspace foundations may be below grade if specific limitations are met including, but not limited to, flood velocities, perimeter wall height, and depth below grade.</p>
<p>Applies to All Zone A</p>		
<p>44 CFR § 60.3(c)(2) Require that all new construction and substantial improvements of residential structures within Zones A1-30, AE, and AH zones on the community's FIRM have the lowest floor (including basement) elevated to or above the base flood level.</p>	<p>Technical Bulletin 10 <i>Ensuring That Structures Built on Fill In or Near Special Flood Hazard Areas Are Reasonably Safe From Flooding</i></p>	<p>The requirement that the lowest floor, including basement, of new and Substantially Improved residential buildings in Zone A be at or above the BFE may be met by elevating buildings on compacted earthen fill material.</p>
	<p>Technical Bulletin 11 <i>Crawlspace Construction for Buildings Located in Special Flood Hazard Areas</i></p>	<p>Although technically basements, below-grade crawlspaces are permitted if communities modify local regulations to explicitly allow below-grade crawlspaces with specific limitations including, but not limited to, flood velocities, perimeter wall height, and depth below grade.</p>

Table 2: Crosswalk of NFIP Regulations, Technical Bulletins, and Key Concepts (cont.)

NFIP Regulation	Technical Bulletin Relevant to the NFIP Regulation	Key Concepts in the NFIP Regulations Covered in the Technical Bulletins
<p>44 CFR § 60.3(c)(3) Require that all new construction and substantial improvements of non-residential structures within Zones A1-30, AE, and AH zones on the community's FIRM (i) have the lowest floor (including basement) elevated to or above the base flood level, or (ii) together with attendant utility and sanitary facilities, be designed so that below the base flood level the structure is watertight with walls substantially impermeable to the passage of water and with structural components having the capability of resisting hydrostatic and hydrodynamic loads and effects of buoyancy.</p>	<p>Technical Bulletin 3 <i>Requirements for the Design and Certification of Dry Floodproofed Non-Residential and Mixed-Use Buildings Located in Special Flood Hazard Areas</i></p> <p>Technical Bulletin 6 <i>Requirements for Dry Floodproofed Below-Grade Parking Areas Under Non-Residential and Mixed-Use Buildings Located in Special Flood Hazard Areas</i></p> <p>Technical Bulletin 10 <i>Ensuring That Structures Built on Fill In or Near Special Flood Hazard Areas Are Reasonably Safe From Flooding</i></p> <p>Technical Bulletin 11 <i>Crawlspace Construction for Buildings Located in Special Flood Hazard Areas</i></p>	<p>Numerous planning and engineering design considerations factor into whether dry floodproofing systems are viable options. Dry floodproofing features include flood shields for openings (doors, windows, louvers), walls and floors that are substantially impermeable and adequately reinforced to withstand floodwater pressures and impact forces generated by floating debris, use of membranes and sealants, installation of pumps, and utility protection.</p> <p>Below-grade parking areas are permitted beneath non-residential and mixed-use buildings in Zone A if buildings and below-grade parking areas are dry floodproofed (watertight and substantially impermeable).</p> <p>The requirement that the lowest floor, including a basement, of new and Substantially Improved non-residential buildings in Zone A be at or above the BFE may be met by elevating buildings on compacted earthen fill material.</p> <p>Although technically basements, below-grade crawlspaces are permitted if communities modify local regulations to explicitly allow below-grade crawlspaces with specific limitations including, but not limited to, flood velocities, perimeter wall height, and depth below grade.</p>
<p>44 CFR § 60.3(c)(4) Provide that where a non-residential structure is intended to be made watertight below the base flood level, (i) a registered professional engineer or architect shall develop and/or review structural design, specifications, and plans for the construction, and shall certify that the design and methods of construction are in accordance with the accepted standards of practice for meeting the applicable provisions of paragraphs (c)(3)(ii) or (c)(8) (ii) of this section, and (ii) a record of such certificates which includes the specific elevation (in relation to mean sea level) to which such structures are floodproofed shall be maintained with the official designated by the community.</p>	<p>Technical Bulletin 3 <i>Requirements for the Design and Certification of Dry Floodproofed Non-Residential and Mixed-Use Buildings Located in Special Flood Hazard Areas</i></p>	<p>FEMA Form 086-0-34, NFIP Floodproofing Certificate for Non-Residential Structures provides information necessary for insurance underwriters to rate dry floodproofed buildings. The same form should be used to satisfy the requirement that design professionals certify designs and as-built drawings and inspection. The certificate contains information on the building, certification of the elevation to which the building is floodproofed, and certification by the design professional that the building has been designed and constructed to the accepted standard of practice (ASCE 24-05, ASCE 24-14, or their equivalent).</p>

Table 2: Crosswalk of NFIP Regulations, Technical Bulletins, and Key Concepts (cont.)

NFIP Regulation	Technical Bulletin Relevant to the NFIP Regulation	Key Concepts in the NFIP Regulations Covered in the Technical Bulletins
<p>44 CFR § 60.3(c)(5) Require, for all new construction and substantial improvements, that fully enclosed areas below the lowest floor that are usable solely for parking of vehicles, building access or storage in an area other than a basement and which are subject to flooding shall be designed to automatically equalize hydrostatic flood forces on exterior walls by allowing for the entry and exit of floodwaters. Designs for meeting this requirement must either be certified by a registered professional engineer or architect or meet or exceed the following minimum criteria: A minimum of two openings having a total net area of not less than one square inch for every square foot of enclosed area subject to flooding shall be provided. The bottom of all openings shall be no higher than one foot above grade. Openings may be equipped with screens, louvers, valves, or other coverings or devices provided that they permit the automatic entry and exit of floodwaters.</p>	<p>Technical Bulletin 1 <i>Requirements for Flood Openings in Foundation Walls and Walls of Enclosures Below Elevated Buildings in Special Flood Hazard Areas</i></p>	<p>Flood openings in foundation walls and walls of enclosures relieve hydrostatic loads, helping to meet the basic performance requirement to prevent flotation, collapse, or lateral movement due to flood forces. Proper design, selection, and installation of flood openings help meet the basic performance requirement to automatically equalize hydrostatic flood forces on exterior walls and prevent flotation, collapse, or lateral movement due to flood forces.</p>
	<p>Technical Bulletin 7 <i>Wet Floodproofing Requirements for Structures Located in Special Flood Hazard Areas</i></p>	<p>Measures known as “wet floodproofing” may be used for specific types of buildings, including detached garages, storage buildings, some agricultural buildings, and buildings that meet the definition for functionally dependent use. Wet floodproofing reduces hydrostatic loads on buildings by allowing floodwater to enter</p>
	<p>Technical Bulletin 11 <i>Crawlspace Construction for Buildings Located in Special Flood Hazard Areas</i></p>	<p>Crawlspaces, including below-grade crawlspaces, are treated as enclosures below elevated buildings. Below-grade crawlspaces may be permitted if communities modify local regulations to explicitly allow below-grade crawlspaces with specific limitations including, but not limited to, flood velocities, perimeter wall height, and depth below grade.</p>
<p>Applies to Zone AO (in addition to requirements for Zone A)</p>		
<p>44 CFR § 60.3(c)(7) Require within any AO zone on the community’s FIRM that all new construction and substantial improvements of residential structures have the lowest floor (including basement) elevated above the highest adjacent grade at least as high as the depth number specified in feet on the community’s FIRM (at least two feet if no depth number is specified).</p>	<p>Technical Bulletin 10 <i>Ensuring That Structures Built on Fill In or Near Special Flood Hazard Areas Are Reasonably Safe From Flooding</i></p>	<p>Placing the lowest floor, including basement, of new and Substantially Improved residential buildings in Zone A at or above the BFE may be accomplished by elevating buildings on compacted earthen fill material.</p>
	<p>Technical Bulletin 11 <i>Crawlspace Construction for Buildings Located in Special Flood Hazard Areas</i></p>	<p>Although technically basements, below-grade crawlspaces are permitted if communities modify local regulations to explicitly allow below-grade crawlspaces with specific limitations including, but not limited to, flood velocities, perimeter wall height, and depth below grade.</p>

Table 2: Crosswalk of NFIP Regulations, Technical Bulletins, and Key Concepts (cont.)

NFIP Regulation	Technical Bulletin Relevant to the NFIP Regulation	Key Concepts in the NFIP Regulations Covered in the Technical Bulletins
<p>44 CFR § 60.3(c)(8) Require within any AO zone on the community's FIRM that all new construction or substantial improvements of nonresidential structures (i) have the lowest floor (including basement) elevated above the highest adjacent grade at least as high as the depth number specified in feet on the community's FIRM (at least two feet if no depth number is specified), or (ii) together with attendant utility and sanitary facilities, be completely floodproofed to that [base flood] level to meet the floodproofing standard specified in paragraph 60.3(c)(3)(ii).</p>	<p>Technical Bulletin 3 <i>Requirements for the Design and Certification of Dry Floodproofed Non-Residential and Mixed-Use Buildings Located in Special Flood Hazard Areas</i></p>	<p>Numerous planning and engineering design considerations factor into whether dry floodproofing is a viable option. Dry floodproofing features include watertight closures, walls and floors that are substantially impermeable and adequately reinforced to withstand base floodwater pressures and impact forces generated by floating debris, use of membranes and sealants, installation of pumps, and utility protection.</p>
	<p>Technical Bulletin 6 <i>Requirements for Dry Floodproofed Below-Grade Parking Areas Under Non-Residential and Mixed-Use Buildings Located in Special Flood Hazard Areas</i></p>	<p>Below-grade parking areas are permitted beneath non-residential and mixed-use buildings in Zone A if the Below-grade parking area is dry floodproofed.</p>
Applies to All Zone V		
<p>44 CFR § 60.3(e)(4) A community shall require that all new construction and substantial improvements in Zones V1-30, VE, and also Zone V if base flood elevation data is available, on the community's FIRM, are elevated on pilings and columns so that: (i) the bottom of the lowest horizontal structural member of the lowest floor (excluding the pilings or columns) is elevated to or above the base flood level; and (ii) the pile or column foundation and the structure attached thereto is anchored to resist flotation, collapse, and lateral movement due to the combined effects of wind and water loads acting simultaneously on all building components. Water loading values used shall be those associated with the base flood. Wind loading values used shall be those required by applicable State or local building standards. A registered professional engineer or architect shall develop or review the structural design, specifications, and plans for the construction, and shall certify that the design and methods of construction to be used are in accordance with accepted standards of practice for meeting the provisions of paragraphs (e)(4)(i) and (ii) of this section.</p>	<p>Technical Bulletin 5 <i>Free-of-Obstruction Requirements for Buildings Located in Coastal High Hazard Areas</i></p>	<p>Obstructions that divert or obstruct the free flow of floodwater and waves below elevated buildings in Zone V could impose additional flood loads on foundation systems or adjacent buildings.</p> <p>Free-of-obstruction requirements apply to: access stairs and ramps; attached and detached decks and porches; elevators; enclosed areas at or above grade; equipment and tanks; foundation bracing; grade beams; shear walls; concrete slabs; accessory storage structures; detached garages; erosion control structures; fences and privacy walls; fill; on-site septic systems; restroom buildings and comfort stations; and swimming pools and spas.</p>
	<p>Technical Bulletin 8 <i>Corrosion Protection for Metal Connectors and Fasteners in Coastal Areas</i></p>	<p>Where buildings are exposed to moisture and airborne salt, corrosion of light gauge metal connectors and fasteners contributes to the loss of load path. Corrosion protection for metal fasteners and connectors in buildings in coastal areas is important in helping to ensure that the buildings are adequately anchored to resist flotation, collapse, and lateral movement due to the combined effects of wind and water loads acting simultaneously on all building components</p>

Table 2: Crosswalk of NFIP Regulations, Technical Bulletins, and Key Concepts (cont.)

NFIP Regulation	Technical Bulletin Relevant to the NFIP Regulation	Key Concepts in the NFIP Regulations Covered in the Technical Bulletins
<p>44 CFR § 60.3(e)(5) Provide that all new construction and substantial improvements within Zones V1-30, VE, and V on the community's FIRM have the space below the lowest floor either free of obstruction or constructed with non-supporting breakaway walls, open wood lattice-work, or insect screening intended to collapse under wind and water loads without causing collapse, displacement, or other structural damage to the elevated portion of the building or supporting foundation system. For the purposes of this section, a breakaway wall shall have a design safe loading resistance of not less than 10 and no more than 20 pounds per square foot. Use of breakaway walls which exceed a design safe loading resistance of 20 pounds per square foot (either by design or when so required by local or State codes) may be permitted only if a registered professional engineer or architect certifies that the designs proposed meet the following conditions: (i) Breakaway wall collapse shall result from a water load less than that which would occur during the base flood; and (ii) The elevated portion of the building and supporting foundation system shall not be subject to collapse, displacement, or other structural damage due to the effects of wind and water loads acting simultaneously on all building components (structural and non-structural). Water loading values used shall be those associated with the base flood. Wind loading values used shall be those required by applicable State or local building standards.</p> <p>Such enclosed space shall be useable solely for parking of vehicles, building access, or storage.</p>	<p>Technical Bulletin 5 <i>Free-of-Obstruction Requirements for Buildings Located in Coastal High Hazard Areas</i></p>	<p>Obstructions that divert or obstruct the free flow of floodwater and waves below elevated buildings in Zone V could impose additional flood loads on foundation systems or adjacent buildings.</p> <p>Free-of-obstruction requirements apply to: access stairs and ramps; attached and detached decks and porches; elevators; enclosed areas at or above grade; equipment and tanks; foundation bracing; grade beams; shear walls; concrete slabs; accessory storage structures; detached garages; erosion control structures; fences and privacy walls; fill; on-site septic systems; restroom buildings and comfort stations; and swimming pools and spas.</p>
	<p>Technical Bulletin 9 <i>Design and Construction Guidance for Breakaway Walls Below Elevated Buildings Located in Coastal High Hazard Areas</i></p>	<p>Walls designed to break away under flood loads help to prevent the walls from obstructing the floodwater and to minimize the transfer of flood and wave loads to the foundations of elevated buildings.</p>

BFE = base flood elevation
 CFR = Code of Federal Regulations
 FEMA = Federal Emergency Management Agency
 FIRM = Flood Insurance Rate Map

4 Key Concepts and Requirements for Structures

Users of the Technical Bulletins should have a basic understanding of the following key concepts:

- Special Flood Hazard Areas (SFHAs)
- Lowest floor, enclosure, and basement
- Substantial Improvement and Substantial Damage
- Open foundations in Zone V

These concepts underlie the requirements that are critical in determining compliance with minimum NFIP floodplain management criteria. Most of these concepts and other key terms used in NFIP regulations are defined in Sections 4 and 5.

4.1 Special Flood Hazard Areas

The SFHA is the land area subject to flooding by the base flood. SFHAs are shown on FIRMs prepared by FEMA as Zones A and V. The base flood is the flood that has a 1 percent chance of being equaled or exceeded in any given year (commonly called the “100 year flood”). FIRMs also show Zone X, which are areas outside the SFHA.

In communities that participate in the NFIP, the minimum floodplain management requirements govern development in SFHAs, including buildings and other structures, subdivisions, new and replacement water supply systems, and new and replacement sanitary sewage systems. Floodplain management requirements for buildings and other structures can differ depending on the flood zone in which a structure is located.

Figure 1 shows the typical flood zones from coastal and riverine flood sources. The criteria for construction in Zones V, VE, V1-30 and VO, which are collectively referred to as Zone V or Coastal High Hazard Areas, are generally more stringent than in Zones A, AE, A1-30, AR, AO, and AH, which are collectively referred to as Zone A. Zone A exists in both coastal and riverine flood source environments.

Zone A. In SFHAs identified as Zone A (Zones A, AE, A1-30, AR, AO, and AH), the principal source of flooding is runoff from rainfall, snowmelt, or coastal storms when the potential base flood wave height is less than 3.0 feet. Zone A has minimum requirements that specify the elevation of the lowest floor, including the basement, in relation to the BFE or depth of the base flood. Specific requirements apply to fully enclosed areas below the lowest floor.

Zone V. Zone V (Zones V, VE, V1-30, and VO), also called Coastal High Hazard Areas, extends from offshore to the inland limit of a primary frontal dune along an open coast, and any other area subject to high-velocity wave

NFIP DEFINITION OF DEVELOPMENT

“Any man-made change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations, or storage of equipment or materials” (44 CFR § 59.1).

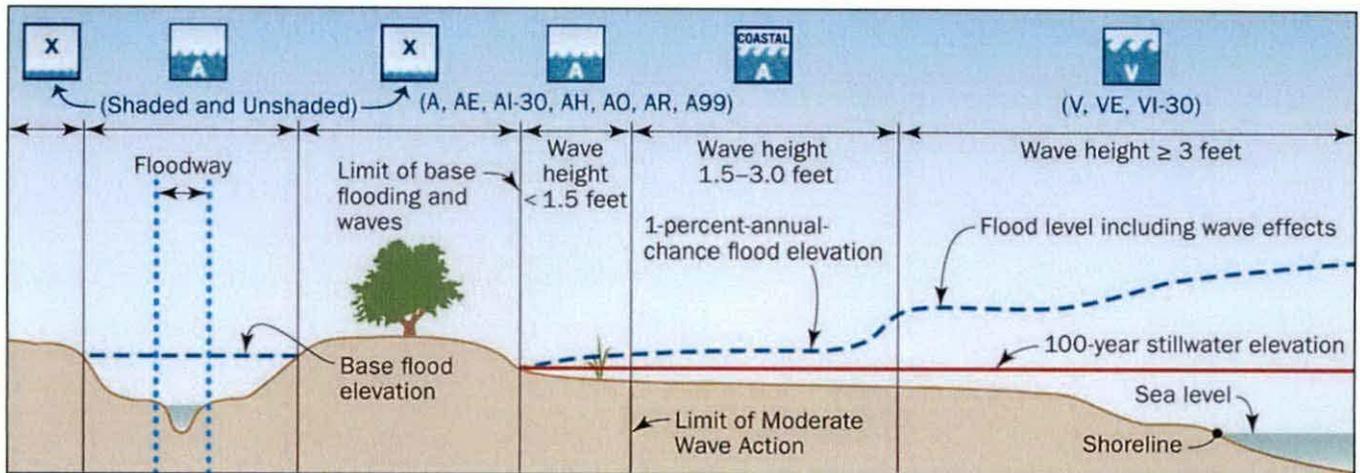


Figure 1: Typical flood zones from coastal and riverine flood sources

action from storms or tsunamis where the potential base flood wave height is 3.0 feet or more. Zone V has minimum requirements pertaining to the siting of buildings, elevation of the lowest horizontal structural member of the lowest floor in relation to the BFE, foundation design, enclosures below the lowest floor, and alterations of sand dunes and mangrove stands.

Zone X. Zone X identifies areas outside the SFHA. Zone X (shaded) identifies two areas of moderate flood hazard: (1) areas subject to inundation by the flood that has a 0.2 percent chance of being equaled or exceeded during any given year (commonly called the “500-year flood”) and (2) areas protected by accredited levee systems. Zone X (unshaded) identifies areas of minimal flood hazard, which are outside the 500-year floodplain. The NFIP floodplain management requirements do not apply in Zone X.

Example of Criteria Difference. An example of a difference in criteria for Zone A and Zone V is where the lowest floor is measured (see Figure 2):

- In Zone A, the lowest floor (including basement) of a structure must be elevated to or above the BFE.
- In Zone V, the bottom of the lowest horizontal structural member of the lowest floor of a structure (excluding pilings or columns) must be elevated to or above the BFE.

COASTAL A ZONE

Since 2009, coastal flood studies have examined wave conditions in Zone A. Based on the studies, FEMA delineates an informational line called the Limit of Moderate Wave Action (LiMWA) on FIRMs where wave heights in Zone A are expected to be 1.5 feet or greater during base flood conditions. See Figure 1.

FEMA uses the term “Coastal A Zone” to refer to areas seaward of the LiMWA and landward of the Zone V boundary or landward of the shoreline where Zone V is not identified. The term refers to some areas identified as Zone A that are subject to flooding from a coastal or tidal source. However, Coastal A Zones are not identified on FIRMs, and the NFIP regulations for development in SFHAs and the NFIP regulations that govern the identification of SFHAs on maps do not use the term “Coastal A Zone.”

The NFIP floodplain management requirements regulate areas identified as Coastal A Zones to Zone A standards. FEMA’s Community Rating System awards credits to communities that regulate Coastal A Zones to Zone V standards. The latest editions of the I-Codes and ASCE 24 require buildings in Coastal A Zones to meet Zone V requirements; FEMA guidance, best practices, and FEMA Mitigation Assessment Team reports support this requirement.

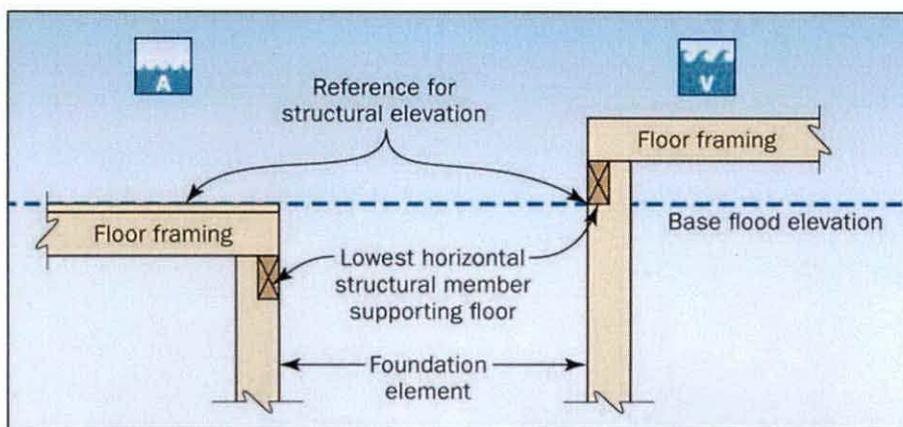


Figure 2: Lowest floor reference point for Zone A (at top of lowest floor) versus Zone V (at bottom of lowest horizontal structural member of lowest floor)

4.2 Lowest Floor, Enclosure, and Basement

Under the NFIP:

- The **lowest floor** is defined as “the lowest floor of the lowest enclosed area (including basement). An unfinished or flood resistant enclosure, usable solely for parking of vehicles, building access or storage in an area other than a basement area is not considered a building’s lowest floor; *Provided*, that such enclosure is not built so as to render the structure in violation of the applicable non-elevation design requirements of § 60.3” (44 CFR § 59.1).
- An **enclosure** is an area below an elevated building that is enclosed by walls on all sides.
- A **basement** is defined as “any area of the building having its floor subgrade (below ground level) on all sides” (44 CFR § 59.1).

4.3 Substantial Improvement and Substantial Damage

The repair or improvement of buildings presents an opportunity to reduce future flood damage to structures and to improve their resilience. Local floodplain management regulations based on the NFIP and building codes contain requirements that apply not only to new structures but also to buildings with proposed Substantial Improvements or repair of Substantial Damage (described below).

As part of issuing permits, local officials must review not only proposals for new construction but also for work on existing buildings to determine whether the work constitutes Substantial Improvement or repair of Substantial Damage. If the work is determined to constitute Substantial Improvement or repair of Substantial Damage, the buildings must be brought into compliance with the NFIP requirements for new construction, including the requirement that the lowest floor be elevated to or above the BFE. Meeting this requirement can also be accomplished by demolishing the building followed by constructing a new building that meets the NFIP requirements on the same site or by relocating the building to outside the SFHA. More information on Substantial Improvement and Substantial Damage can be found in FEMA P-758, *Substantial Improvement/Substantial Damage Desk Reference* (2010), and FEMA 213, *Answers to Questions About Substantially Improved/Substantially Damaged Buildings* (2018).

Substantial Improvement is defined in 44 CFR § 59.1 as:

... Any reconstruction, rehabilitation, addition, or other improvement of a structure, the cost of which equals or exceeds 50 percent of the market value of the structure before the “start of construction” of the improvement. This term includes structures which have incurred “substantial damage,” regardless of the actual repair work performed. The term does not, however, include either:

- (1) Any project for improvement of a structure to correct existing violations of state or local health, sanitary, or safety code specifications which have been identified by the local code enforcement official and which are the minimum necessary to assure safe living conditions or
- (2) Any alteration of a “historic structure,” provided that the alteration will not preclude the structure’s designation as a “historic structure.”

Substantial Damage is defined in 44 CFR § 59.1 as “damage of any origin sustained by a structure whereby the cost of restoring the structure to its before-damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred.” Substantial Damage can have any cause, not just flooding.

Some communities modify the definitions of Substantial Improvement and Substantial Damage requirements in one of two ways: (1) adopting a lower threshold than 50 percent (e.g., 40 percent, 30 percent) or (2) tracking costs of improvements and costs of repairs over a specific period, referred to as “cumulative Substantial Improvement.”

4.4 Open Foundations in Zone V

Coastal waves and flooding can exert strong hydrodynamic forces on any building element that is exposed to waves or the flow of water. Therefore, open foundation systems that offer minimal resistance to waves and floodwaters passing beneath elevated buildings (e.g., pile and column foundations) are required in Zone V.

The NFIP requires that all new construction and Substantially Improved buildings in Zone V be elevated to or above the BFE on open foundations (pilings, columns) that allow floodwater and waves to pass beneath the elevated structure. The NFIP further requires that areas below elevated structures remain free of obstructions that would prevent the free flow of coastal floodwater and waves during a base flood event. The NFIP considers shear walls acceptable in limited circumstances where lateral loads on upper stories of buildings cannot be adequately resisted by piling or column foundations.

COASTAL A ZONE WAVE HAZARD

Coastal A Zones are subject to conditions similar to those in Zone V (Coastal High Hazard Areas), including breaking waves, erosion, and scour.

Although the minimum NFIP requirements for Coastal A Zones are the same as Zone A, it is recommended that structures in Coastal A Zones be designed and constructed to Zone V standards.



Flood Damage-Resistant Materials Requirements

for Buildings Located in Special Flood Hazard Areas in
accordance with the National Flood Insurance Program

Technical Bulletin 2 / August 2008



FEMA

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Revision to Table 2 footnote (*) made in October 2010.

Comments on the Technical Bulletins should be directed to:

Department of Homeland Security
FEMA Federal Insurance and Mitigation Administration
500 C Street, SW.
Washington, D.C. 20472

Technical Bulletin 2-08 replaces Technical Bulletin 2-93, *Flood-Resistant Materials Requirements for Buildings Located in Special Flood Hazard Areas in accordance with the National Flood Insurance Program.*

Introduction

Protecting buildings that are constructed in special flood hazard areas (SFHAs) from damage caused by flood forces is an important objective of the National Flood Insurance Program (NFIP). In support of this objective, the NFIP regulations include minimum building design criteria that apply to new construction, repair of substantially damaged buildings, and substantial improvement of existing buildings in SFHAs. The base flood is used to delineate SFHAs on Flood Insurance Rate Maps (FIRMs) prepared by the NFIP. The base flood is the flood that has a 1-percent chance of being equaled or exceeded in any given year (commonly called the “100-year” flood). Certain terms used in this Technical Bulletin are defined in the Glossary.

The NFIP regulations require the use of construction materials that are resistant to flood damage. The lowest floor of a residential building must be elevated to or above the base flood elevation (BFE), while the lowest floor of a non-residential building must be elevated to or above the BFE or dry floodproofed to the BFE.

All construction below the BFE is susceptible to flooding and must consist of flood damage-resistant building materials. The purpose of this Technical Bulletin is to provide current guidance on what constitute “materials resistant to flood damage” and how and when these materials must be used to improve a building’s ability to withstand flooding.

Table 1 describes five classes of materials ranging from those that are highly resistant to floodwater damage, to those that have no resistance to flooding. Materials are broadly described as structural materials and finish materials based on how they are used in normal construction practices. Table 2 lists materials by generic names, and notes whether the materials are acceptable or unacceptable for use below the BFE. All building materials are in some way fastened or connected to the structure. Fasteners and connectors, as described in this Technical Bulletin, also must be resistant to flood damage.

A brief description of the process used to identify or determine whether the materials listed are flood damage-resistant is provided, followed by some simplified examples with diagrams to illustrate the use of these materials below the BFE. Three additional circumstances where flood damage-resistant materials are used or recommended are described: accessory structures, limited use of wet floodproofing, and buildings outside of SFHAs.

Questions about use of flood damage-resistant materials should be directed to the appropriate local official, NFIP State Coordinating Office, or one of the Federal Emergency Management Agency’s (FEMA’s) Regional Offices.

Under the NFIP, the “lowest floor” is the floor of the lowest enclosed area of a building. An unfinished or flood-resistant enclosure that is used solely for parking of vehicles, building access, or storage is not the lowest floor, provided the enclosure is built in compliance with applicable requirements.

As used by the NFIP, an “enclosure” is an area that is enclosed on all sides by walls.

The NFIP defines a “basement” as any area that is below-grade on all sides. The regulations do not allow basements to extend below the BFE.

NFIP Regulations

The NFIP regulations for flood damage-resistant materials are codified in Title 44 of the Code of Federal Regulations, in Section 60.3(a)(3), which states that a community shall:

“Review all permit applications to determine whether proposed building sites will be reasonably safe from flooding. If a proposed building site is in a floodprone area, all new construction and substantial improvements shall... (ii) be constructed with materials resistant to flood damage...”

Proposals for substantial improvement of existing buildings in SFHAs, and proposals to repair those that have sustained substantial damage, must comply with the requirements for new construction. As part of issuing permits, community officials must review such proposals to determine whether they comply with the requirements, including the use of flood damage-resistant materials. Refer to the “Classification of Flood Damage-Resistant Materials” section of this Technical Bulletin for additional details. Further information on substantial improvement and substantial damage is found in *Answers to Questions About Substantially Damaged Buildings* (FEMA 213).

The NFIP Technical Bulletins provide guidance on the minimum requirements of the NFIP regulations. Community or State requirements that exceed those of the NFIP take precedence. Design professionals should contact the community to determine whether more restrictive provisions apply to the building or site in question. All other applicable requirements of the State or local building codes must also be met for buildings in all flood hazard areas.

Required Use of Flood Damage-Resistant Materials

Flood Damage-Resistant Material

“Flood [damage]-resistant material” is defined by the NFIP as “any building product [material, component or system] capable of withstanding direct and prolonged contact with floodwaters without sustaining significant damage.” The term “prolonged contact” means at least 72 hours, and the term “significant damage” means any damage requiring more than cosmetic repair. “Cosmetic repair” includes cleaning, sanitizing, and resurfacing (e.g., sanding, repair of joints, repainting) of the material. The cost of cosmetic repair should also be less than the cost of replacement of affected materials and systems. In addition to these requirements, individual materials that are considered flood damage-resistant must not cause degradation of adjacent materials or the systems of which the material is a part.

The *International Building Code*® (IBC), by reference to ASCE 24 *Flood Resistant Design and Construction*, and the *International Residential Code*® (IRC), require the use of flood damage-resistant materials.

All building materials below the BFE must be flood damage-resistant, regardless of the expected or historic flood duration. For example, buildings in coastal areas that experience relatively short-duration flooding (generally, flooding with a duration of less than 24 hours) must be constructed with flood damage-resistant materials below the BFE. As noted in Table 2, only Class 4 and Class 5 materials are acceptable for areas below the BFE in buildings in SFHAs.

In some instances, materials that are not flood damage-resistant materials, such as wiring for fire alarms and emergency lighting, are allowed below the BFE if specifically required to address life safety and electric code requirements for building access and storage areas.

How Flood Damage-Resistant Materials Affect Flood Insurance Rates

Careful attention to compliance with the NFIP regulations for flood damage-resistant materials is important during design, plan review, construction, and inspection. Compliance influences both the building's vulnerability to flood damage and the cost of NFIP flood insurance. Flood insurance will not pay a claim for finish materials located in basements or in enclosed areas below the lowest floor of elevated buildings, even if such materials are considered to be flood damage-resistant. NFIP claims for damage below the BFE are limited to utilities and equipment, such as furnaces and water heaters.

Classification of Flood Damage-Resistant Materials

The information in this Technical Bulletin was initially developed based on information in the U.S. Army Corps of Engineers' *Flood Proofing Regulations* (1995), and has been updated based on additional information from FEMA-funded studies and reports, technical experts, and industry and trade groups. Table 1 classifies building materials according to their ability to resist flood damage.

Table 1. Class Descriptions of Materials

NFIP	Class	Class Description
ACCEPTABLE	5	Highly resistant to floodwater ¹ damage, including damage caused by moving water. ² These materials can survive wetting and drying and may be successfully cleaned after a flood to render them free of most harmful pollutants. ³ Materials in this class are permitted for partially enclosed or outside uses with essentially unmitigated flood exposure.
	4	Resistant to floodwater ¹ damage from wetting and drying, but less durable when exposed to moving water. ² These materials can survive wetting and drying and may be successfully cleaned after a flood to render them free of most harmful pollutants. ³ Materials in this class may be exposed to and/or submerged in floodwaters in interior spaces and do not require special waterproofing protection.
UNACCEPTABLE	3	Resistant to clean water ⁴ damage, but not floodwater damage. Materials in this class may be submerged in clean water during periods of flooding. These materials can survive wetting and drying, but may not be able to be successfully cleaned after floods to render them free of most ³ harmful pollutants.
	2	Not resistant to clean water ⁴ damage. Materials in this class are used in predominantly dry spaces that may be subject to occasional water vapor and/or slight seepage. These materials cannot survive the wetting and drying associated with floods.
	1	Not resistant to clean water ⁴ damage or moisture damage. Materials in this class are used in spaces with conditions of complete dryness. These materials cannot survive the wetting and drying associated with floods.

Notes:

1. Floodwater is assumed to be considered "black" water; black water contains pollutants such as sewage, chemicals, heavy metals, or other toxic substances that are potentially hazardous to humans.
2. Moving water is defined as water moving at low velocities of 5 feet per second (fps) or less. Water moving at velocities greater than 5 fps may cause structural damage to building materials.
3. Some materials can be successfully cleaned of most of the pollutants typically found in floodwater. However, some individual pollutants such as heating oil can be extremely difficult to remove from uncoated concrete. These materials are flood damage-resistant except when exposed to individual pollutants that cannot be successfully cleaned.
4. Clean water includes potable water as well as "gray" water; gray water is wastewater collected from normal uses (laundry, bathing, food preparation, etc.).

MODIFIED FROM: USACE 1995 *Flood Proofing Regulations*

Table 2 lists structural materials and finish materials commonly used in construction of floors, walls, and ceilings. For the purpose of this Technical Bulletin, structural materials and finish materials are defined as follows:

- **Structural materials** include all elements necessary to provide structural support, rigidity, and integrity to a building or building component. Structural materials include floor slabs, beams, subfloors, framing, and structural building components such as trusses, wall panels, I-joists and headers, and interior/exterior sheathing.

- **Finish materials** include all coverings, finishes, and elements that do not provide structural support or rigidity to a building or building component. Finish materials include floor coverings, wall and ceiling surface treatments, insulation, cabinets, doors, partitions, and windows.

Notes Regarding Classification of Materials

The classifications in Table 2 are based on the best information available at the time of publication. However, flood damage-resistance is determined by factors that may be a function of the specific application and by the characteristics of the floodwaters. Each situation requires sound judgment and knowledge of probable contaminants in local floodwaters to select materials that are required to resist flood damage. For materials and products that are listed in Table 2, manufacturers' use and installation instructions must be followed to ensure maximum performance. Masonry and wood products used below the BFE must comply with the applicable standards published by the American Society for Testing and Materials (ASTM), the American Concrete Institute (ACI), the Truss Plate Institute (TPI), the American Forest & Paper Association (AF&PA), and other appropriate organizations.

1. **Materials Not Listed:** Table 2 does not list all available structural materials and finish materials. For materials and products not listed, manufacturers' literature (i.e., specifications, materials safety data sheets, test reports) should be evaluated to determine if the product meets flood damage-resistance requirements. Materials and products that are not listed in Table 2 may be used if accepted by the local official. Acceptance should be based on sufficient evidence, provided by the applicant, that the materials proposed to be used below the BFE will resist flood damage without requiring more than cosmetic repair and cleaning.
2. **Unacceptable Materials:** Class 1, 2, and 3 materials are unacceptable for below-BFE applications for one or more of the following reasons:
 - Normal adhesives specified for above-grade use are water soluble or are not resistant to alkali or acid in water, including groundwater seepage and vapor.
 - The materials contain wood or paper products, or other materials that dissolve or deteriorate, lose structural integrity, or are adversely affected by water.
 - Sheet-type floor coverings (linoleum, rubber tile) or wall coverings (wallpaper) restrict drying of the materials they cover.
 - Materials are dimensionally unstable.
 - Materials absorb or retain excessive water after submergence.
3. **Impact of Material Combinations:** In some cases, the combination of acceptable structural and finish materials can negatively impact the classification of individual materials. This is illustrated by the following examples:

- Vinyl tile with chemical-set adhesives is an acceptable finish flooring material when placed on a concrete structural floor. However, when the same vinyl tile is applied over a plywood structural floor, it is no longer considered acceptable because the vinyl tile must be removed to allow the plywood to dry.
 - Polyester-epoxy or oil-based paints are acceptable wall finishes when applied to a concrete structural wall. However, when the same paint is applied to a wood wall, it is no longer considered acceptable. Recent FEMA-supported studies by Oak Ridge National Laboratory have found that low-permeability paint can inhibit drying of the wood wall.
4. **Impact of Long-Duration Exposure and/or Contaminants:** The classifications of materials listed in Table 2 do not take into account the effects of long-duration exposure to floodwaters or contaminants carried by floodwaters. This is illustrated by the following examples:
- Following Hurricane Katrina, FEMA deployed a Mitigation Assessment Team (MAT) to examine how building materials performed after long-duration exposure (2 to 3 weeks) to floodwaters (FEMA 549). The field survey revealed that some materials absorbed floodborne biological and chemical contaminants. However, it is not known at this time if a shorter duration flood event would have significantly altered the absorption rates of those contaminants.
 - Building owners, design professionals, and local officials should consider potential exposure to floodborne contaminants when selecting flood damage-resistant materials. For example, Table 2 lists cast-in-place concrete, concrete block, and solid structural wood (2x4s, etc.), as acceptable flood damage-resistant materials. However, experience has shown that buildings with those materials can be rendered unacceptable for habitation after being subjected to floodwaters with significant quantities of petroleum-based products such as home heating oil. Commonly used cleaning and remediation practices do not reduce the “off-gassing” of volatile hydrocarbons from embedded oil residues to acceptable levels that are established by the U.S. Environmental Protection Agency. Other materials, when exposed to these types of contaminants, may also not perform acceptably as flood damage-resistant materials.

Table 2. Types, Uses, and Classifications of Materials

Types of Building Materials	Uses of Building Materials		Classes of Building Materials				
	Floors	Walls/ Ceilings	Acceptable		Unacceptable		
			5	4	3	2	1
Structural Materials (floor slabs, beams, subfloors, framing, and interior/exterior sheathing)							
Asbestos-cement board		■	■				
Brick							
Face or glazed		■	■				
Common (clay)		■		■			
Cast stone (in waterproof mortar)		■	■				
Cement board/fiber-cement board		■	■				
Cement/latex, formed-in-place	■			■			
Clay tile, structural glazed		■	■				
Concrete, precast or cast-in-place	■	■	■				
Concrete block ¹		■	■				
Gypsum products							
Paper-faced gypsum board		■			■		
Non-paper-faced gypsum board		■		■			
Greenboard		■				■	
Keene's cement or plaster		■			■		
Plaster, otherwise, including acoustical		■				■	
Sheathing panels, exterior grade		■			■		
Water-resistant, fiber-reinforced gypsum exterior sheathing		■		■			
Hardboard (high-density fiberboard)							
Tempered, enamel or plastic coated		■				■	
All other types		■					■
Mineral fiberboard		■					■
Oriented-strand board (OSB)							
Exterior grade	■	■				■	
Edge swell-resistant OSB	■	■				■	
All other types	■	■					■
Particle board	■						■
Plywood							
Marine grade	■	■	■				
Preservative-treated, alkaline copper quaternary (ACQ) or copper azole (C-A)	■	■		■			

Table 2. Types, Uses, and Classifications of Materials (continued)

Types of Building Materials	Uses of Building Materials		Classes of Building Materials				
	Floors	Walls/ Ceilings	Acceptable		Unacceptable		
			5	4	3	2	1
Structural Materials (floor slabs, beams, subfloors, framing, and interior/exterior sheathing)							
Preservative-treated, Borate ²	■	■	■				
Exterior grade/Exposure1 (WBP – weather and boil proof)	■	■		■			
All other types	■	■					■
Recycled plastic lumber (RPL)							
Commingled, with 80-90% polyethylene (PE)	■		■				
Fiber-reinforced, with glass fiber strands	■		■				
High-density polyethylene (HDPE), up to 95%	■		■				
Wood-filled, with 50% sawdust or wood fiber	■				■		
Stone							
Natural or artificial non-absorbent solid or veneer, waterproof grout	■	■	■				
All other applications		■				■	
Structural Building Components							
Floor trusses, wood, solid (2x4s), decay-resistant or preservative-treated	■	■		■			
Floor trusses, steel ³	■		■				
Headers and beams, solid (2x4s) or plywood, exterior grade or preservative-treated		■		■			
Headers and beams, OSB, exterior grade or edge-swell resistant		■				■	
Headers and beams, steel ³		■	■				
I-joists	■					■	
Wall panels, plywood, exterior grade or preservative-treated		■		■			
Wall panels, OSB, exterior grade or edge-swell resistant		■				■	
Wall panels, steel ³		■		■			

Table 2. Types, Uses, and Classifications of Materials (continued)

Types of Building Materials	Uses of Building Materials		Classes of Building Materials				
	Floors	Walls/ Ceilings	Acceptable		Unacceptable		
			5	4	3	2	1
Structural Materials (floor slabs, beams, subfloors, framing, and interior/exterior sheathing)							
Wood							
Solid, standard, structural (2x4s)		■		■			
Solid, standard, finish/trim		■			■		
Solid, decay-resistant ⁴	■	■	■				
Solid, preservative-treated, ACQ or C-A		■		■			
Solid, preservative-treated, Borate ²		■		■			
Finish Materials (floor coverings, wall and ceiling finishes, insulation, cabinets, doors, partitions, and windows)							
Asphalt tile ⁵							
With asphaltic adhesives	■				■		
All other types	■						■
Cabinets, built-in							
Wood		■				■	
Particle board		■					■
Metal ³		■		■			
Carpeting	■						■
Ceramic and porcelain tile							
With mortar set	■	■		■			
With organic adhesives	■	■				■	
Concrete tile, with mortar set	■		■				
Corkboard		■				■	
Doors							
Wood, hollow		■				■	
Wood, lightweight panel construction		■				■	
Wood, solid		■				■	
Metal, hollow ³		■		■			
Metal, wood core ³		■		■			
Metal, foam-filled core ³		■		■			
Fiberglass, wood core		■		■			
Epoxy, formed-in-place	■		■				

Table 2. Types, Uses, and Classifications of Materials (continued)

Types of Building Materials	Uses of Building Materials		Classes of Building Materials				
	Floors	Walls/ Ceilings	Acceptable		Unacceptable		
			5	4	3	2	1
Finish Materials (floor coverings, wall and ceiling finishes, insulation, cabinets, doors, partitions, and windows)							
Glass (sheets, colored tiles, panels)		■		■			
Glass blocks		■	■				
Insulation							
Sprayed polyurethane foam (SPUF) or closed-cell plastic foams	■	■	■				
Inorganic – fiberglass, mineral wool: batts, blankets, or blown	■	■			■		
All other types (cellulose, cotton, open-cell plastic foams, etc.)	■	■				■	
Linoleum	■						■
Magnesite (magnesium oxychloride)	■						■
Mastic felt-base floor covering	■						■
Mastic flooring, formed-in-place	■		■				
Metals, non-ferrous (aluminum, copper, or zinc tiles)		■			■		
Metals							
Non-ferrous (aluminum, copper, or zinc tiles)		■			■		
Metals, ferrous ³		■		■			
Paint							
Polyester-epoxy and other oil-based waterproof types		■		■			
Latex		■		■			
Partitions, folding							
Wood		■				■	
Metal ³		■		■			
Fabric-covered		■					■
Partitions, stationary (free-standing)							
Wood frame		■		■			
Metal ³		■		■			
Glass, unreinforced		■		■			
Glass, reinforced		■		■			
Gypsum, solid or block		■					■

Table 2. Types, Uses, and Classifications of Materials (continued)

Types of Building Materials	Uses of Building Materials		Classes of Building Materials				
	Floors	Walls/ Ceilings	Acceptable		Unacceptable		
			5	4	3	2	1
Finish Materials (floor coverings, wall and ceiling finishes, insulation, cabinets, doors, partitions, and windows)							
Polyurethane, formed-in-place	■		■				
Polyvinyl acetate (PVA) emulsion cement	■						■
Rubber							
Moldings and trim with epoxy polyamide adhesive or latex-hydraulic cement		■		■			
All other applications		■					■
Rubber sheets or tiles⁵							
With chemical-set adhesives ⁶	■		■				
All other applications	■						■
Silicone floor, formed-in-place	■		■				
Steel (panels, trim, tile)							
With waterproof adhesives ³		■	■				
With non-waterproof adhesives		■				■	
Terrazo	■			■			
Vinyl asbestos tile (semi-flexible vinyl)⁵							
With asphaltic adhesives	■		■				
All other applications	■						■
Vinyl sheets or tiles (coated on cork or wood product backings)	■						■
Vinyl sheets or tiles (homogeneous)⁵							
With chemical-set adhesives ⁶	■			■			
All other applications	■						■
Wall coverings							
Paper, burlap, cloth types		■					■
Vinyl, plastic, wall paper		■					■
Wood floor coverings							
Wood (solid)	■						■
Engineered wood flooring	■					■	
Plastic laminate flooring	■					■	
Wood composition blocks, laid in cement mortar	■					■	
Wood composition blocks, dipped and laid in hot pitch or bitumen	■					■	

Notes*:

- 1 Unfilled concrete block cells can create a reservoir that can hold water following a flood, which can make the blocks difficult or impossible to clean if the floodwaters are contaminated.
 - 2 Borate preservative-treated wood meets the NFIP requirements for flood damage-resistance; however, the borate can leach out of the wood if the material is continuously exposed to standing or moving water.
 - 3 Not recommended in areas subject to salt-water flooding.
 - 4 Examples of decay-resistant lumber include heart wood of redwood, cedar, and black locust. Refer to Section 2302 of the International Building Code® (IBC®) and Section R202 of the International Residential Code® (IRC®) for guidance.
 - 5 Using normally specified suspended flooring (i.e., above-grade) adhesives, including sulfite liquor (lignin or "linoleum paste"), rubber/asphaltic dispersions, or "alcohol" type resinous adhesives (culmar, oleoresin).
 - 6 Examples include epoxy-polyamide adhesives or latex-hydraulic cement.
- * In addition to the requirements of TB 2 for flood damage resistance, building materials must also comply with any additional requirements of applicable building codes. For example, for wood products such as solid 2x4s and plywood, applicable building code requirements typically include protection against decay and termites and will specify use of preservative-treated or decay-resistant wood for certain applications. Applications that require preservative-treated or decay-resistant species include wood in contact with the ground, wood exposed to weather, wood on exterior foundation walls, or wood members close to the exposed ground. In some cases, applicable building code requirements (such as those in ASCE 24-05 and IRC 2006) do not reflect updated guidance in TB 2 and specify that all wood used below the design flood elevation be preservative-treated or naturally decay-resistant regardless of proximity to ground or exposure to weather. (Revision made in October 2010)

Fasteners and Connectors

The term "fasteners" typically refers to nails, screws, bolts, and anchors. The term "connectors" typically refers to manufactured devices used to connect two or more building components. Joist hangers, post bases, hurricane ties and clips, and mud-sill anchors are examples of connectors. Fasteners and connectors are materials and thus must be made of flood damage-resistant materials in order to comply with the NFIP requirements.

Table 2 does not specifically address fasteners and connectors. However, it is clear that the performance of buildings that are exposed to flooding is, at least in part, a function of the fasteners and connectors used to put the components together.

When preservative-treated woods are used, particular attention is required for fasteners and connectors because some treatments are more corrosive than others, which could shorten the service life of the fasteners and connectors. For example, alkaline copper quaternary (ACQ) treatments are more corrosive than traditional acid copper chromate (ACC) treatments. If corrosion occurs, buildings are less likely to withstand flood loads and other loads. Fasteners and connectors made of stainless steel, hot-dipped zinc-coated galvanized steel, silicon bronze, or copper are recommended for use with preservative-treated wood.

This Technical Bulletin, consistent with ASCE 24 and the International Code Series, recommends that stainless steel or hot-dip galvanized fasteners and connectors be used below the BFE in both inland (noncorrosive) and coastal (corrosive) areas. In coastal environments where airborne salts contribute to corrosion, it is recommended that corrosion-resistant fasteners and connectors be used throughout the building where they may be exposed. For

Specifications for fasteners and connectors used in buildings in SFHAs are in ASCE 24, a standard referenced by the IBC. Chapter 23 of the IBC has specific requirements for connections and fasteners used with wood, including preservative-treated wood. Similar specifications are in Chapter 3 of the IRC.

additional guidance, see Technical Bulletin 8, *Corrosion Protection for Metal Connectors in Coastal Areas*. Also see TPI/WTCA *Guidelines for Use of Alternative Preservative Treatments with Metal Connector Plates* for further guidance on metal plate connected wood trusses manufactured with preservative treated lumber (<http://www.sbcindustry.com/images/PTWGuidelines.pdf>).

Construction Examples

Buildings in Zones A, AE, A1-A30, AR, AO, and AH

Figure 1 illustrates a solid foundation wall (crawl-space) elevated to meet the minimum requirement that the lowest floor be at the BFE. Figure 2 illustrates framed walls that may be used for enclosures below the BFE that are used for parking of vehicles, building access, and storage.

To maximize allowable use of enclosures below the BFE, it is a common practice to extend the foundation a full story, even though that puts the lowest floor well above the BFE. In such cases, while the NFIP requirement is that flood damage-resistant materials be used only below the BFE, it is strongly recommended that such materials be used for all construction below the lowest floor. This will reduce flood damage to the enclosed area in the event flooding exceeds the BFE. For additional guidance on enclosures in A zones, see Technical Bulletin 1, *Openings in Foundation Walls and Walls of Enclosures Below Elevated Buildings in Special Flood Hazard Areas*.

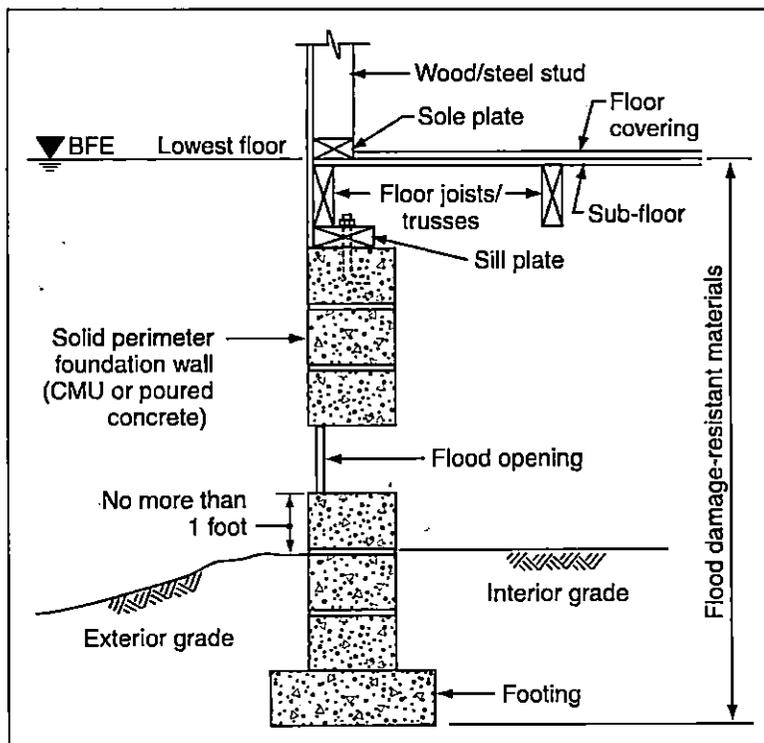


Figure 1. Building elevated on solid foundation walls meeting the minimum NFIP requirements for Zones A, AE, A1-A30, AR, AO, and AH

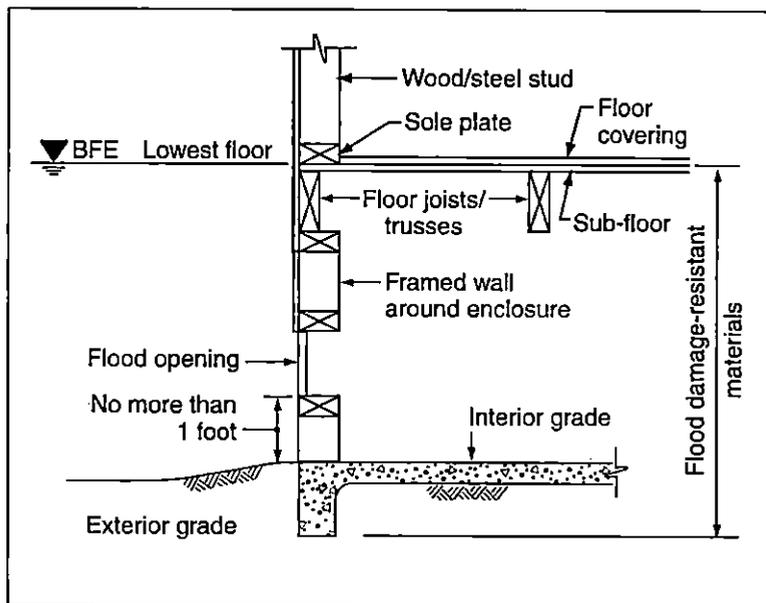


Figure 2. Framed enclosure under building elevated in accordance with NFIP requirements for Zones A, AE, A1-A30, AO, and AH

Buildings in Zones V, VE, and V1-V30

The NFIP regulations require that the bottom of the lowest horizontal structural member of the lowest floor (usually the floor beam or girder) of buildings in Zones V, VE, and V1-V30 be at or above the BFE. Therefore, all materials below the bottom of those members must be flood damage-resistant materials. This requirement applies to lattice work and screening, and also to materials used to construct breakaway walls that enclose areas below the lowest floor. Depending on the design parameters selected, breakaway walls may remain in place during low-level floods and must be flood damage-resistant so that they can be readily cleaned and not deteriorate over time due to wetting. Figure 3 illustrates the requirement. For additional guidance on breakaway walls used to enclose areas under buildings in V zones, see Technical Bulletin 9, *Design and Construction Guidance for Breakaway Walls Below Elevated Coastal Buildings*.

Additional Uses of Flood Damage-Resistant Materials

Accessory Structures

Accessory structures may be allowed in SFHAs provided they are located, installed, and constructed in ways that comply with NFIP requirements. Some communities allow accessory structures that are limited to the uses specified for enclosures below the BFE: parking of vehicles and storage. As with other buildings, accessory structures below the BFE are required to be constructed with flood damage-resistant materials. In addition, accessory structures must be anchored to resist flotation, collapse, and lateral movement and comply with other requirements based on the flood zone. For additional information and requirements, contact the appropriate community permitting office.

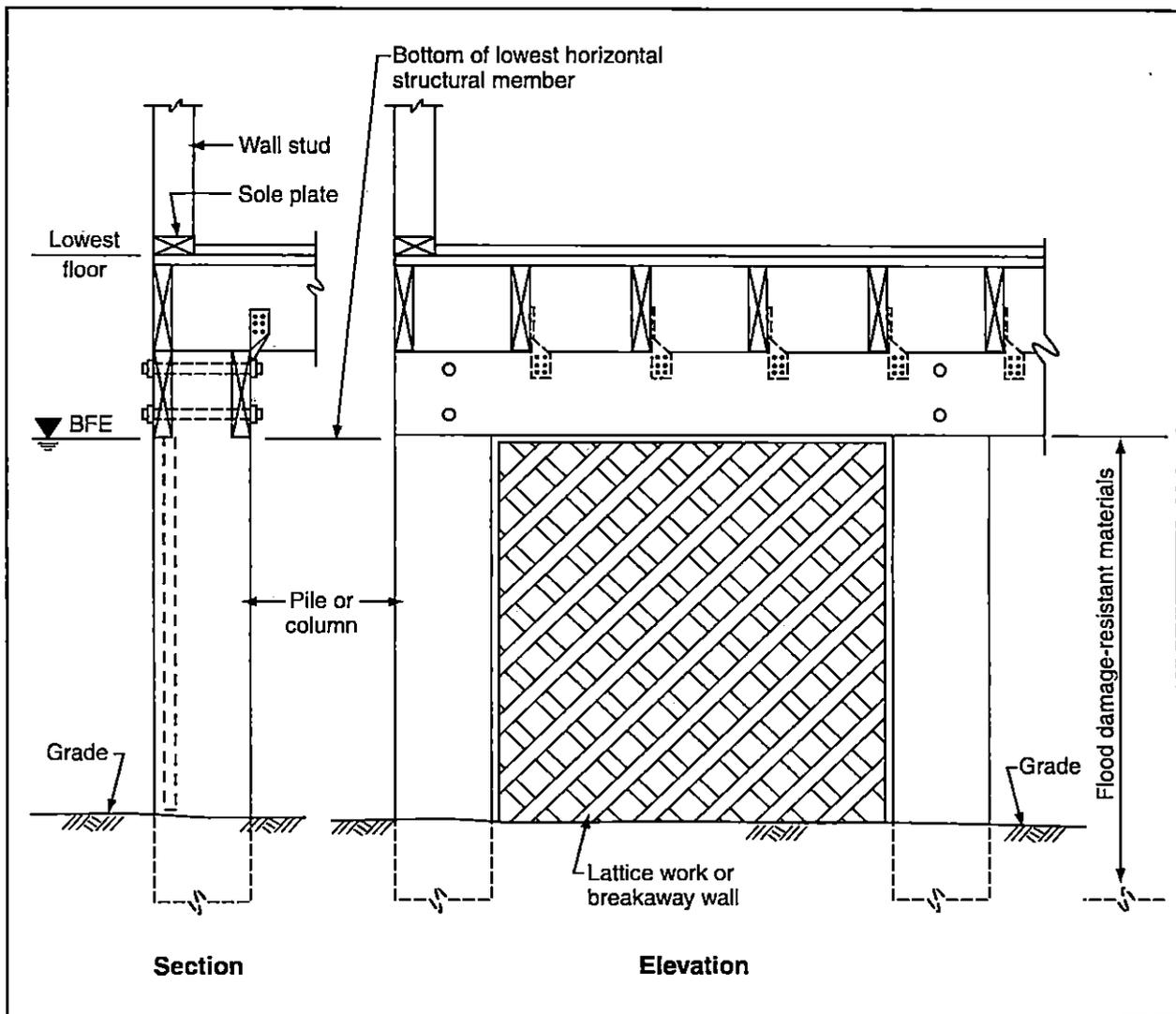


Figure 3. Flood damage-resistant building material requirements for buildings elevated in accordance with NFIP requirements for Zones V, VE, and V1-V30

Wet Floodproofing

Wet floodproofing is a method to reduce damage that typically involves three elements: allowing floodwaters to enter and exit to minimize structural damage, using flood damage-resistant materials, and elevating utility service and equipment. When a building is retrofitted to be wet floodproofed, non-flood damage-resistant materials that are below the BFE should be removed and replaced with flood damage-resistant materials. This will reduce the costs of repair and facilitate faster recovery.

Wet floodproofing is not allowed in lieu of complying with the lowest floor elevation requirements for new residential buildings (or dry floodproofing of nonresidential buildings in A zones). The exception is accessory structures, as noted on the previous page. Wet floodproofing may also be used to voluntarily retrofit buildings that are older than the date of the community's first FIRM (commonly referred to as "pre-FIRM"), provided the requirement to

bring such buildings into compliance is not triggered (called “substantial improvement”). Figure 4 illustrates some suggested retrofitting of interior walls in a pre-FIRM building. However, please note that the techniques illustrated in Figure 4 cannot be used to bring a substantially damaged or substantially improved building into compliance with the NFIP. For additional information on wet floodproofing, see Technical Bulletin 7, *Wet Floodproofing Requirements*.

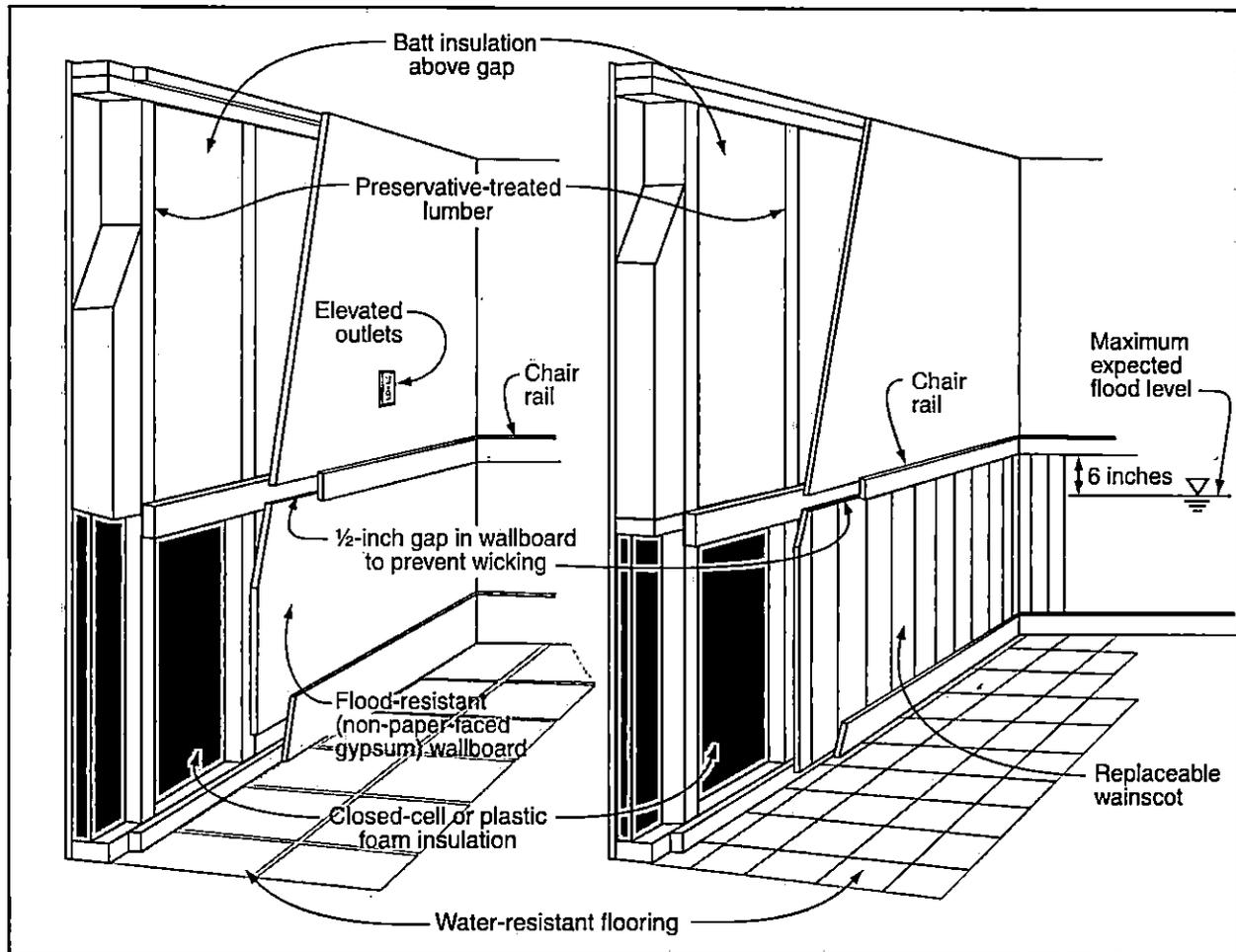


Figure 4. Partial wet floodproofing technique using flood damage-resistant materials for finished wall construction.

Buildings Outside of SFHAs

FEMA reports that up to 25 percent of NFIP flood insurance claims are paid on buildings that are outside of the mapped SFHA. This occurs for many reasons, including out-of-date maps and local drainage problems. In areas known to be prone to flooding that are not subject to the NFIP requirements, it is recommended that flood damage-resistant materials be used for construction of new buildings and for repair or renovation of existing buildings. Figure 4 illustrates some options.

The NFIP

The U.S. Congress established the NFIP with the passage of the National Flood Insurance Act of 1968. The NFIP is a Federal program enabling property owners in participating communities to purchase insurance as protection against flood losses, in exchange for State and community floodplain management regulations that reduce future flood damages. Participation in the NFIP is based on an agreement between communities and the Federal Government. If a community adopts and enforces adequate floodplain management regulations, FEMA will make flood insurance available within the community.

Title 44 of the U.S. Code of Federal Regulations contains the NFIP criteria for floodplain management, including design and construction standards for new and substantially improved buildings located in SFHAs identified on the NFIP's FIRMs. FEMA encourages communities to adopt floodplain management regulations that exceed the NFIP criteria. As an insurance alternative to disaster assistance, the NFIP reduces the escalating costs of repairing damage to buildings and their contents caused by floods.

NFIP Technical Bulletins

This is one of a series of Technical Bulletins that FEMA has produced to provide guidance concerning the building performance requirements of the NFIP. These requirements are contained in Title 44 of the U.S. Code of Federal Regulations at Section 60.3. The bulletins are intended for use by State and local officials responsible for interpreting and enforcing the requirements in their floodplain management regulations and building codes, and by members of the development community, such as design professionals and builders. New bulletins, as well as updates of existing bulletins, are issued periodically, as necessary. The bulletins do not create regulations; rather, they provide specific guidance for complying with the requirements of existing NFIP regulations. Users of the Technical Bulletins who need additional guidance should contact their NFIP State Coordinator or the appropriate FEMA regional office. *The User's Guide to Technical Bulletins* (<http://www.fema.gov/pdf/fima/guide01.pdf>) lists the bulletins issued to date.

Ordering Technical Bulletins

The quickest and easiest way to acquire copies of FEMA's Technical Bulletins is to download them from the FEMA website (<http://www.fema.gov/plan/prevent/floodplain/techbul.shtm>).

Technical Bulletins also may be ordered free of charge from the FEMA Distribution Center by calling 1-800-480-2520, or by faxing a request to 1-240-699-0525, Monday through Friday between 8 a.m. and 5 p.m. EST. Please provide the FEMA publication number, title, and quantity of each publication requested, along with your name, address, zip code, and daytime telephone number. Written requests may be submitted by email to: FEMA-Publications-Warehouse@dhs.gov

Further Information

The following publications provide further information concerning the use of flood damage-resistant materials.

Algan, H. and Wendt, R. 2005. *Pre-Standard Development for the Testing of Flood-Damage-Resistant Residential Envelope Systems, Comparison of Field and Laboratory Results - Summary Report*, Oak Ridge National Laboratory, June 2005.

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U.S. Army Corps of Engineers. 1995. *Flood Proofing Regulations*, Chapters 9 and 10, U.S. Army Corps of Engineers, EP 1165-2-314.

Wood Truss Council of America (WTCA). 2005. *The Load Guide: Guide to Good Practice for Specifying and Applying Loads to Structural Building Components*, (<http://www.sbcindustry.com/loads.php>).

World Floor Covering Association (WFCA). n.d., Anaheim, California (<http://www.wfca.org/index.html>).

Glossary

Accessory structure — A structure that is on the same parcel of property as a principal structure, the use of which is incidental to the use of the principal structure.

Base flood — The flood having a 1-percent chance of being equaled or exceeded in any given year, commonly referred to as the “100-year flood.” The base flood is the national standard used by the NFIP and all Federal agencies for the purposes of requiring the purchase of flood insurance and regulating new development.

Base flood elevation (BFE) — The height of the base (1-percent annual chance or 100-year) flood in relation to a specified datum, usually the National Geodetic Vertical Datum of 1929, or the North American Vertical Datum of 1988.

Basement — Any area of a building having its floor subgrade (below ground level) on all sides.

Enclosure or enclosed area — Areas created by a crawlspace or solid walls that fully enclose areas below the BFE.

Federal Emergency Management Agency (FEMA) — The Federal agency that, in addition to carrying out other activities, administers the National Flood Insurance Program.

Federal Insurance and Mitigation Administration (FIMA) — The component of FEMA directly responsible for administering the flood hazard identification and floodplain management aspects of the NFIP.

Flood Insurance Rate Map (FIRM) — The official map of a community on which FEMA has delineated both the special flood hazard areas (SFHAs) and the risk premium zones applicable to the community.

Floodprone area — Any land area susceptible to being inundated by floodwater from any source.

Lowest floor — The lowest floor of the lowest enclosed area of a building, including a basement. Any NFIP-compliant unfinished or flood-resistant enclosure usable solely for parking of vehicles, building access, or storage (in an area other than a basement) is not considered a building's lowest floor, provided the enclosure does not render the structure in violation of the applicable design requirements of the NFIP.

Registered Design Professional — An individual who is registered or licensed to practice their respective design profession as defined by the statutory requirements of the professional registration laws of the State or jurisdiction in which the project is to be constructed.

Special Flood Hazard Area (SFHA) — An area delineated on a FIRM as being subject to inundation by the base flood and designated as Zone A, AE, AI-A30, AR, AO, AH, A99, V, VE, or V1-V30.

Substantial damage — Damage of any origin sustained by a structure whereby the cost of restoring the structure to its before-damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred. Structures that are determined to be substantially damaged are considered to be substantial improvements, regardless of the actual repair work performed.

Substantial improvement — Any reconstruction, rehabilitation, addition, or other improvement of a structure, the cost of which equals or exceeds 50 percent of the market value of the structure (or smaller percentage if established by the community) before the “start of construction” of the improvement. This term includes structures that have incurred “substantial damage,” regardless of the actual repair work performed.