



Flood Damage-Resistant Materials Requirements

For Buildings Located in Special Flood Hazard Areas in
Accordance with the National Flood Insurance Program

NFIP Technical Bulletin 2 / January 2025



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

NFIP Technical Bulletin 2 (2025) replaces NFIP Technical Bulletin 2, *Flood Damage-Resistant Materials Requirements* (2008).

All illustrations in this document were created by FEMA or a FEMA contractor unless otherwise noted.

Cover photo: Garage space with flood damage-resistant materials and hydrostatic openings below the base flood elevation and building access and an electrical outlet above the base flood elevation (location unknown).

Portions of this publication, NFIP Technical Bulletin 2, contains substantial copyrighted material from the 2024 *International Residential Code for One- or Two-Family Dwellings* (IRC), 2024 *International Building Code* (IBC), and the 2024 *International Existing Building Code* (IEBC) which are copyrighted works owned by the International Code Council, Inc. (the "ICC"). Without advance written permission from ICC, no part of this publication containing ICC-owned material may be reproduced, distributed, or transmitted in any form or by any means, including, without limitation, electronic, optical, or mechanical means (by way of example and not limitation, photocopying, or recording by or in an information storage retrieval system). For information on permission to copy material exceeding fair use, please contact: Publications. 4051 West Flossmoor Road, Country Club Hills, IL 60478. Phone 1-888-ICC-SAFE (422-7233).

NFIP Technical Bulletin 2 contains information that is proprietary to and copyrighted by the American Society of Civil Engineers. All information is used in accordance with the ASCE permissions policy (<https://ascelibrary.org/page/guidelinesforpermissions>).

For more information, see the FEMA Building Science Frequently Asked Questions website at

<https://www.fema.gov/emergency-managers/risk-management/building-science/faq>.

If you have any additional questions on FEMA Building Science Publications, contact the helpline at FEMABuildingsciencehelp@fema.dhs.gov or 866-927-2104.

You may also sign up for the FEMA Building Science email subscription, which is updated with publication releases and FEMA Building Science activities. Subscribe at https://service.govdelivery.com/accounts/USDHSFEMA/subscribe/new?topic_id=USDHSFEMA_193.

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

To order publications, contact the FEMA Distribution Center:

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

Fax: 719-948-9724

Email: FEMApubs@gpo.gov

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

Scan this QR code to visit the FEMA Building Science webpage.



Table of Contents

1. Introduction.....	1
1.1. Definition of Flood Damage-Resistant Materials	2
1.2. Required Use of Flood Damage-Resistant Materials	2
1.3. Classification of Flood Damage-Resistant Materials	2
2. NFIP Regulations	3
3. Building Codes and Standards.....	4
3.1. International Residential Code.....	5
3.2. International Building Code and ASCE 24	5
3.3. International Existing Building Code	5
4. NFIP Flood Insurance Implications	6
5. Ratings of Flood Damage-Resistant Materials	6
5.1. Types, Uses, and Flood Damage-Resistance Ratings of Materials.....	6
5.2. Evaluating Unrated Materials.....	14
5.3. Impact of Material Combinations on Ratings.....	14
5.4. Impact of Long-Duration Exposure to Floodwaters and Exposure to Contaminants on Flood Damage-Resistant Materials	15
6. Connectors and Fasteners	15
7. Examples of Flood Damage-Resistant Construction Techniques	16
7.1. Buildings in Zone A	16
7.2. Buildings in Zone V	18
7.3. Buildings Designed and Constructed for Flood Elevations above the Minimum NFIP Requirements	19
8. Additional Uses of Flood Damage-Resistant Materials	20
8.1. Dry Floodproofing.....	20
8.2. Accessory Structures	21
8.3. Wet Floodproofing.....	21

9. Buildings Outside Special Flood Hazard Areas.....	22
10. References and Resources	23
10.1. References	23
10.2. Resources.....	25

Appendix

Appendix A: Detailed Comparison of Building Codes and Standards with NFIP Requirements

Figures

Figure 1	Building in Zone A elevated on solid foundation walls	17
Figure 2	Framed enclosure in Zone A under elevated building.....	18
Figure 3	Flood damage-resistant building materials in Zone V.....	19
Figure 4	Flood damage-resistant building materials when freeboard is required	20
Figure 5	Partial wet floodproofing technique in finished wall construction when NFIP compliance is not required.....	22

Tables

Table 1	Common Structural Materials, Uses, and Flood Damage-Resistance Ratings.....	8
Table 2	Common Finish Materials, Uses, and Flood Damage-Resistance Ratings	11

Acronyms

ACQ	alkaline copper quaternary
ASCE	American Society of Civil Engineers
ASTM	ASTM International, formerly known as American Society for Testing and Materials
BFE	base flood elevation
C-A	copper azole
CFR	Code of Federal Regulations
DFE	design flood elevation
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
IBC®	International Building Code®
ICC®	International Code Council®
I-Codes®	International Codes®
IEBC®	International Existing Building Code®
IRC®	International Residential Code®
n.d.	no date
NFIP	National Flood Insurance Program
OSB	oriented-strand board
SEI	Structural Engineering Institute
SFHA	Special Flood Hazard Area
TPI	Truss Plate Institute
USACE	U.S. Army Corps of Engineers
WTCA	Wood Truss Council of America

This page intentionally left blank

1. Introduction

This Technical Bulletin provides guidance on the National Flood Insurance Program's (NFIP's) requirements on the use of construction materials that are resistant to flood damage in Special Flood Hazard Areas (SFHAs). SFHAs are identified as Zone A (A, AE, A1-30, AH, AO, and AR) and Zone V (V, VE, V1-30, and VO) on a community's Flood Insurance Rate Map (FIRM) prepared by the Federal Emergency Management Agency (FEMA).

Since all construction below the base flood elevation (BFE) is susceptible to flooding, the NFIP requires the use of flood damage-resistant structural and finish materials below the BFE in SFHAs. In Zone A, the lowest floor of a residential building must be elevated to or above the BFE, while the lowest floor of a non-residential building must be elevated or dry floodproofed to or above the BFE. In Zone V, the building must be elevated on pilings or columns with the bottom of the lowest horizontal structural member of the lowest floor elevated to or above the BFE. Dry floodproofing in Zone V is not allowed.

This Technical Bulletin is intended to provide the current guidance on what constitutes materials resistant to flood damage and how and when these materials must be used to improve a building's ability to withstand flooding.

Building materials are divided in this Technical Bulletin into structural and finish materials based on how they are used in normal construction practices. Section 5 of this Technical Bulletin provides lists of common structural and finish materials, including their generic names, specific descriptions, and whether they are typically used in floor and/or wall and ceiling construction, and whether they are acceptable or unacceptable for use below the BFE in SFHAs.

All building materials are fastened or connected to the structure in some way. Connectors and fasteners, as described in this Technical Bulletin, must also be resistant to flood damage.

This Technical Bulletin includes a brief description of the processes that are used to determine whether materials are flood damage resistant, including 2024 ASTM International (ASTM) standards that can be used to determine whether building materials are considered flood damage-resistant. This Technical Bulletin also provides diagrams with example uses of these materials below the BFE, and discusses four additional circumstances in which flood damage-resistant materials are used or recommended: dry floodproofing, accessory structures, limited use of wet floodproofing, and buildings outside SFHAs.

NFIP Technical Bulletin 0

NFIP Technical Bulletin 0, *User's Guide to Technical Bulletins*, should be used as a reference with this Technical Bulletin. Technical Bulletin 0 describes the purpose and use of the Technical Bulletins. It includes common concepts and terms, lists useful resources, and includes a crosswalk of the NFIP regulations by section and the applicable Technical Bulletin, as well as a subject index.

Readers are cautioned that the definitions of some of the terms that are used in the Technical Bulletins are not the same when used by the NFIP for the purpose of rating flood insurance policies.

1.1. Definition of Flood Damage-Resistant Materials

Flood damage-resistant materials are defined as any building product [material, component, or system] capable of withstanding direct and prolonged contact with floodwater 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 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.

1.2. Required Use of Flood Damage-Resistant Materials

Building materials below the BFE in SFHAs must be flood damage resistant regardless of the historical or expected flood duration. For example, buildings in coastal areas that experience relatively short-duration flooding (generally less than 24 hours) must be constructed with flood damage-resistant materials below the BFE.

Materials that are not flood damage resistant, such as wiring for fire alarms and emergency lighting that conform to the provisions of NFPA 70 National Electric Code for wet locations, may be allowed below the BFE if they are required in order to meet life-safety and electrical building code provisions for building access and storage areas.

1.3. Classification of Flood Damage-Resistant Materials

This Technical Bulletin was initially developed based on the U.S. Army Corps of Engineers (USACE) *Flood Proofing Regulations* (USACE, 1995), FEMA-funded studies and reports, and information from technical experts and industry and trade groups.

In *Flood Proofing Regulations* (USACE, 1995) and the previous edition of Technical Bulletin 2 (FEMA, 2008), materials are classified on a scale of 1 to 5 according to their ability to resist damage from floodwaters or clean water. Classes 1, 2, and 3 are considered unacceptable as flood damage-

resistant materials, and Classes 4 and 5 are considered acceptable. However, subsequent reviews and observations have indicated that distinctions between unacceptable Class 1, 2 and 3 materials and acceptable Class 4 and 5 materials may be subjective and are unnecessary for NFIP compliance. Therefore, this Technical Bulletin does not classify materials, but instead rates them as acceptable or unacceptable for flood damage-resistance. Moreover, this change from five classifications to two ratings (acceptable and unacceptable) of flood damage-resistant materials is consistent with the latest ASTM Standards (ASTM, 2024a; ASTM, 2024b) described in Section 5.2 of this Technical Bulletin.

NFIP Terms Used in This Technical Bulletin

- **Special Flood Hazard Area (SFHA):** Area subject to flooding by the base flood (1%-annual-chance flood) and shown on Flood Insurance Rate Maps (FIRMs) as Zone A or Zone V
- **Zone A:** Flood zones shown on FIRMs as Zone A, AE, A1-30, AH, AO, A99, and AR
- **Zone V:** Flood zones shown on FIRMs as Zone V, VE, V1-30, and VO; also known as the Coastal High Hazard Area

2. NFIP Regulations

An important NFIP objective is protecting buildings constructed in SFHAs from damage caused by flooding. 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 % chance of being equaled or exceeded in any given year (commonly called the 100-year flood).

The NFIP floodplain management regulations include minimum building design criteria that apply to:

- New construction
- Work determined to be a substantial improvement, including improvements, alterations, and additions
- Repair of buildings determined to have incurred substantial damage

The NFIP regulations on flood damage-resistant materials are codified in [Title 44 of the Code of Federal Regulations \(CFR\) Part 60. Criteria for Land Management and Use](#). Specific to this Technical Bulletin, 44 CFR Sections 60.3(a)(3) and (a)(3)(ii) state that a community shall:

(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 ...

(ii) be constructed with materials resistant to flood damage ...

NFIP Requirements and Higher Regulatory Standards

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

Substantial Improvement and Substantial Damage. As part of issuing permits, local officials must review proposals for new construction and 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 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).

Elevation Above Minimum NFIP Required Elevation. Some states and communities require that buildings be elevated above the minimum NFIP required elevation. The additional elevation is called freeboard. Design professionals, builders, and property owners should check with local officials to determine whether a community has freeboard requirements. References to building elevations in this Technical Bulletin should be construed as references to the community's elevation requirement when freeboard is required.

3. Building Codes and Standards

In NFIP participating communities, in addition to complying with 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 by states and communities.

The International Codes® (I-Codes®), published by the International Code Council® (ICC®), are a family of codes that 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. FEMA has deemed that the latest editions of the I-Codes generally meet or exceed NFIP requirements for buildings and structures. Excerpts of the flood provisions of the I-Codes and highlights from ASCE 7 and ASCE 24 are available on FEMA's Building Code webpage at <https://www.fema.gov/emergency-managers/risk-management/building-science/building-codes>.

3.1. International Residential Code

The IRC applies to one- and two-family dwellings and townhomes not more than three stories above grade plane. The IRC requirements related to the use of flood damage-resistant materials are summarized and compared to NFIP requirements in Appendix A, Table A-1.

International Residential Code Commentary

The ICC publishes companion commentary for the IRC. Although not regulatory, the commentary provides guidance that is useful in complying with, clarifying, interpreting, and enforcing the requirements of the code.

3.2. International Building Code and ASCE 24

The flood provisions in the latest editions of the IBC generally meet or exceed NFIP requirements for buildings largely through reference to the standard ASCE 24, *Flood Resistant Design and Construction* (ASCE, 2014). While the IBC is used primarily for buildings and structures other than dwellings within the scope of the IRC, the IBC may be used to design dwellings. The IBC and ASCE 24 requirements related to the use of flood damage-resistant materials are summarized and compared to NFIP requirements in Appendix A, Table A-2.

International Building Code and ASCE 24 Commentaries

The ICC publishes companion commentary for the IBC, and ASCE includes commentary in ASCE 24. Although not regulatory, the commentaries provide information and guidance that are useful in complying with, clarifying, interpreting, and enforcing requirements.

3.3. International Existing Building Code

The International Existing Building Code (IEBC) applies to the repair, alteration, change of occupancy, addition to, or relocation of existing buildings and structures. The I-Codes defines an existing building as “a building [or structure] erected prior to the date of adoption of the appropriate code, or one for which a legal building permit has been issued.”

The IEBC requirements related to the use of flood damage-resistant materials are summarized and compared to NFIP requirements in Appendix A, Table A-3.

International Existing Code Commentary

The ICC publishes companion commentary for the IEBC. Although not regulatory, the commentary provides guidance that is useful in complying with, interpreting, and enforcing the requirements of the code.

4. NFIP Flood Insurance Implications

Careful attention to compliance with the NFIP regulations for flood damage-resistant materials is important during design, plan review, construction, and inspection. Compliance influences the building's vulnerability to flood damage and also the cost of NFIP flood insurance. NFIP flood insurance will not pay a claim for finish materials located in basements or installed or located below the lowest floor of a post-FIRM elevated building that is located in most SFHAs even if such materials are considered flood damage-resistant. In most cases, NFIP claims for damage below the BFE are limited. Designers, builders, and owners may wish to contact a qualified insurance agent with NFIP experience for more information on policy coverage, coverage limits, and premium costs.

NFIP Flood Insurance Terms

- **Post-FIRM Building:** A building for which construction or substantial improvement occurred after Dec. 31, 1974, or on or after the effective date of an initial FIRM, whichever is later.
- **Pre-FIRM Building:** A building for which construction or substantial improvement occurred on or before Dec. 31, 1974, or before the effective date of an initial FIRM.

5. Ratings of Flood Damage-Resistant Materials

The classifications of flood damage-resistant materials in this Technical Bulletin have been consolidated in this edition based on a review of information in FEMA-funded studies and reports as well as discussions with technical experts. This edition replaces “classification” with “rating” based on the latest ASTM standards (ASTM, 2024a; ASTM, 2024b), described in Section 5.2 of this Technical Bulletin. Materials that have not been rated may be rated in accordance with the guidance in the ASTM standards.

5.1. Types, Uses, and Flood Damage-Resistance Ratings of Materials

For the purposes of this Technical Bulletin, two types of building materials—structural and finish—are used in the construction of floors, walls, and ceilings. Structural and finish materials are defined as follows:

- **Structural materials.** All elements necessary to provide structural support, rigidity, and integrity to a building or building component including floor slabs, beams, subfloors, framing, and structural building components such as trusses, wall panels, I-joists, headers, and interior/exterior sheathing.
- **Finish materials.** All coverings, finishes, and elements that do not provide structural support or rigidity to a building or building component including floor coverings, wall and ceiling surface treatments, insulation, cabinets, and materials used to fabricate doors, partitions, and windows.

Table 1 lists the uses and flood damage-resistance ratings of common structural materials, and Table 2 lists the uses and flood damage-resistance ratings of common finish materials. The ratings in Table 1 and 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 application and floodwater characteristics. Selecting materials that meet the requirement to resist flood damage requires sound judgment and knowledge of probable contaminants in local floodwaters. For the materials and products that are listed in Table 1 and Table 2, manufacturers' use and installation instructions must be followed to ensure optimum performance. The inclusion of a building material in Table 1 and Table 2 is not a precise indication of how the material will perform when inundated by floodwaters, subjected to high velocity water, or impacted by debris.

Building materials below the BFE must also comply with the applicable building code requirements and standards.

As discussed in Section 1 of this Technical Bulletin, previous editions of this Technical Bulletin classified building materials according to their ability to resist flood damage using five classes, with Classes 1, 2, and 3 considered unacceptable and Classes 4 and 5 materials considered acceptable. However, given the limited information to verify classifications, the right-most column in Tables 1 and 2 has been changed from "Classes of Building Materials" to "Flood Damage-Resistance Rating." The two ratings are acceptable and unacceptable.

Table 1: Common Structural Materials, Uses, and Flood Damage-Resistance Ratings

Structural Material	Description	Commonly Used in		Flood Damage-Resistance Rating
		Floors	Walls/Ceilings	
Asbestos-cement board	—	No	Yes	Acceptable
Brick	Face, glazed, or common (clay)	No	Yes	Acceptable
Cast stone	In waterproof mortar	No	Yes	Acceptable
Cement board/ fiber-cement board	—	No	Yes	Acceptable
Cement/latex	Formed-in-place	Yes	No	Acceptable
Clay tile	Structural glazed	No	Yes	Acceptable
Concrete	Precast or cast-in-place	Yes	Yes	Acceptable
Concrete block ⁽¹⁾	—	No	Yes	Acceptable
Gypsum products	Non-paper-faced gypsum board or water-resistant, fiber-reinforced gypsum exterior sheathing	No	Yes	Acceptable
Gypsum products	Paper-faced gypsum board, Keene's cement or plaster, sheathing panels (exterior grade), greenboard, and plaster (other, including acoustical)	No	Yes	Unacceptable
Hardboard (high-density fiberboard)	Tempered (enameled or plastic-coated) and all other types	No	Yes	Unacceptable
Mineral fiberboard	—	No	Yes	Unacceptable
Oriented-strand board (OSB)	Exterior grade, edge swell-resistant, and all other types	Yes	Yes	Unacceptable
Particle board	—	Yes	Yes	Unacceptable

Structural Material	Description	Commonly Used in		Flood Damage-Resistance Rating
		Floors	Walls/Ceilings	
Plywood	Marine grade, preservative-treated with borate, ⁽²⁾ alkaline copper quaternary (ACQ), and copper azole (C-A); or exterior grade/exposure ⁽¹⁾ (weather and boil proof [WBP])	Yes	Yes	Acceptable
Plywood	All other types	Yes	Yes	Unacceptable
Recycled plastic lumber (RPL)	Comingled with 80 to 90% polyethylene (PE), fiber-reinforced with glass fiber strands, or high-density polyethylene (HDPE) up to 95%	Yes	Yes	Acceptable
Recycled plastic lumber (RPL)	Wood-filled with 50% sawdust or wood fiber	Yes	Yes	Unacceptable
Stone	Natural or artificial non-absorbent solid or veneer, waterproof grout	Yes	Yes	Acceptable
Stone	All other applications	Yes	Yes	Unacceptable
Structural building components	Floor trusses, steel, ⁽³⁾ or solid wood (e.g., 2x4s, 2x6s, 2x8s), decay resistant or preservative treated	Yes	Yes	Acceptable
Structural building components	Headers and beams, steel, ⁽³⁾ or solid wood (e.g., 2x4s, 2x6s, 2x8s)/plywood, exterior grade or preservative treated; wall panels, steel ⁽³⁾ or plywood, exterior grade or preservative-treated	Yes	Yes	Acceptable
Structural building components	I-joists	Yes	Yes	Unacceptable
Structural building components	Headers and beams, OSB, exterior grade or edge-swell resistant	No	Yes	Unacceptable
Wood	Solid, decay resistant ⁽⁴⁾	Yes	Yes	Acceptable

Flood Damage-Resistant Materials Requirements

Structural Material	Description	Commonly Used in		Flood Damage-Resistance Rating
		Floors	Walls/Ceilings	
Wood	Solid, standard, structural (e.g., 2x4s, 2x6s, 2x8s), or preservative-treated with borate, ⁽²⁾ ACQ, or C-A	Yes	Yes	Acceptable
Wood	Solid, standard, finish/trim	Yes	Yes	Unacceptable

Notes:

- (1) Unfilled concrete block cells can create a reservoir that can hold water following a flood, which can make blocks difficult or impossible to clean if the floodwaters are contaminated.
- (2) Borate preservative-treated wood meets the NFIP requirements for flood damage resistance, but the borate can leach out of the wood if the material is exposed continuously to standing or moving water.
- (3) Not recommended in areas subject to saltwater flooding.
- (4) Examples of decay-resistant lumber include heart wood of redwood, cedar, and black locust. Refer to Section 2302 of the IBC® and Section R202 of the IRC® for guidance.

Table 2: Common Finish Materials, Uses, and Flood Damage-Resistance Ratings

Finish Material	Description	Commonly Used in		Flood Damage-Resistance Rating
		Floors	Walls/Ceilings	
Asphalt tile ⁽¹⁾	With asphaltic adhesives and all other types	Yes	No	Unacceptable
Cabinets, built-in	Metal ⁽²⁾	No	Yes	Acceptable
Cabinets, built-in	Wood, particle board	No	Yes	Unacceptable
Carpeting	—	Yes	No	Unacceptable
Ceramic and porcelain tile	With mortar set	Yes	Yes	Acceptable
Ceramic and porcelain tile	With organic adhesives	Yes	Yes	Unacceptable
Concrete tile	With mortar set	Yes	No	Acceptable
Corkboard	—	No	Yes	Unacceptable
Doors	Fiberglass, wood core; metal ⁽²⁾ with wood core, foam-filled core, or hollow	No	Yes	Acceptable
Doors	Wood, hollow, solid, or lightweight panel construction	No	Yes	Unacceptable
Epoxy flooring	Formed-in-place	Yes	No	Acceptable
Glass	Sheets, colored tiles, panels	No	Yes	Acceptable
Glass blocks	—	No	Yes	Acceptable
Insulation	Sprayed polyurethane foam (SPUF) or closed-cell plastic foams	Yes	Yes	Acceptable
Insulation	Inorganic – fiberglass, mineral wool (batts, blankets, or blown); all other types (e.g., cellulose, cotton, open-cell plastic foams)	Yes	Yes	Unacceptable
Linoleum	—	Yes	No	Unacceptable

Finish Material	Description	Commonly Used in		Flood Damage-Resistance Rating
		Floors	Walls/Ceilings	
Magnesite (magnesium oxychloride)	—	Yes	Yes	Unacceptable
Mastic flooring	Formed-in-place	Yes	No	Acceptable
Mastic floor covering	Felt-base	Yes	No	Unacceptable
Metals	Ferrous ⁽²⁾	No	Yes	Acceptable
Metals	Non-ferrous (aluminum, copper or zinc tiles)	Yes	Yes	Unacceptable
Paint	Latex, polyester-epoxy, and other oil-based waterproof types	No	Yes	Acceptable
Partitions, folding	Metal ⁽²⁾	No	Yes	Acceptable
Partitions, folding	Wood, fabric-covered	No	Yes	Unacceptable
Partitions, stationary (free-standing)	Wood frame, metal, ⁽²⁾ glass (reinforced or unreinforced)	No	Yes	Acceptable
Partitions, stationary (free-standing)	Gypsum, solid or block	No	Yes	Unacceptable
Polyurethane	Formed-in-place	Yes	No	Acceptable
Polyvinyl acetate (PVA) emulsion cement	—	Yes	No	Unacceptable
Rubber	Moldings and trim with epoxy polyamide adhesive or latex-hydraulic cement	No	Yes	Acceptable
Rubber	All other applications	No	Yes	Unacceptable
Rubber sheets or tiles ⁽¹⁾	With chemical-set adhesives ⁽³⁾	Yes	No	Acceptable

Finish Material	Description	Commonly Used in		Flood Damage-Resistance Rating
		Floors	Walls/Ceilings	
Rubber sheets or tiles ⁽¹⁾	All other applications	Yes	No	Unacceptable
Silicone floor	Formed-in-place	Yes	No	Acceptable
Steel (panels, trim, tile)	With waterproof adhesives ⁽²⁾	Yes	Yes	Acceptable
Steel (panels, trim, tile)	With non-waterproof adhesives	Yes	Yes	Unacceptable
Terrazzo	—	Yes	Yes	Acceptable
Vinyl asbestos tile (semi-flexible vinyl) ⁽¹⁾	With asphaltic adhesives	Yes	No	Acceptable
Vinyl asbestos tile (semi-flexible vinyl) ⁽¹⁾	All other applications	Yes	No	Unacceptable
Vinyl sheets or tiles	Coated on cork or wood product backings	Yes	No	Unacceptable
Vinyl sheets or tiles (homogeneous) ⁽¹⁾	With chemical-set adhesives ⁽³⁾	Yes	No	Acceptable
Vinyl sheets or tiles (homogeneous) ⁽¹⁾	All other applications	Yes	No	Unacceptable
Wall coverings	Vinyl, plastic, paper, wall paper, burlap, cloth types	No	Yes	Unacceptable
Wood floor coverings	Engineered wood flooring, plastic laminate flooring, wood composition blocks (laid in cement mortar, or dipped and laid in hot pitch or bitumen), wood (solid)	Yes	No	Unacceptable

Notes:

(1) Using normally specified suspended flooring (i.e., above-grade) adhesives including sulfite liquor (linguin or “linoleum paste”), rubber/asphaltic dispersions, or “alcohol” type resinous adhesives (culmar, oleresin).

(2) Not recommended in areas subject to saltwater flooding.

(3) Examples include epoxy-polyamide adhesives or latex-hydraulic cement.

A structural material in Table 1 or a finish material in Table 2 may be rated unacceptable for below-BFE applications for one or more of the following reasons:

- The material contains normal adhesives, which are specified for above-grade use and water soluble or 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.
- The material restricts drying of the materials it covers.
- The material is dimensionally unstable.
- The material absorbs or retains excessive water after submergence.

5.2. Evaluating Unrated Materials

Table 1 and Table 2 are not comprehensive lists of available structural and finish materials. For materials that are not listed, manufacturer's literature (e.g., specifications, materials safety data sheets, test reports) should be reviewed to determine whether the materials meet flood damage-resistance requirements. Materials that are not listed in Table 1 and Table 2 may be used if accepted by the local official as flood damage resistant. Acceptance should be based on sufficient applicant-provided evidence that the materials proposed to be used below the BFE will resist flood damage without requiring more than cosmetic repair and cleaning.

In March 2024, ASTM International (ASTM) published ASTM E3075, *Standard Test Method for Water Immersion and Drying for Evaluation of Flood Damage Resistance* (ASTM, 2024a), and ASTM E3369, *Standard Specification for Determining the Flood Damage Resistance Rating of Building Materials* (ASTM, 2024b). When used together, these ASTM standards provide manufacturers, designers, building owners, local officials and other interested stakeholders with a method of determining whether a building material or assembly not listed in this Technical Bulletin is acceptable for flood damage-resistance.

5.3. Impact of Material Combinations on Ratings

Combining acceptable structural and finish materials may negatively impact the rating of each material. For example:

- Vinyl tile with chemical-set adhesives is an acceptable finish flooring material when placed on a concrete structural floor, but when the same vinyl tile is applied over a plywood structural floor, it is not 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, but when the same paint is applied to a wood wall, it is not considered acceptable. A FEMA-supported study at Oak Ridge National Laboratory found that low-permeability paint can inhibit drying of a wood wall (Algan and Wendt, 2004).

In general, combinations of materials in a system that traps water, does not allow water to drain freely by gravity, or restricts air circulation and thus the ability to dry to the interior or exterior of the

system can lead to unacceptable performance. When combinations of acceptable materials are used in a system with limited performance history, an evaluation of the system in accordance with ASTM (2024a) and ASTM (2024b) is recommended.

For all materials used, designers must design, owners must use, and local officials must ensure that the system complies with the manufacturer's installation instructions.

5.4. Impact of Long-Duration Exposure to Floodwaters and Exposure to Contaminants on Flood Damage-Resistant Materials

The material ratings in Table 1 and Table 2 do not take into account the effects of long-duration exposure to floodwaters (2 to 3 weeks) or to contaminants carried by floodwaters. For example, following Hurricane Katrina, FEMA deployed a Mitigation Assessment Team to examine how building materials performed after long-duration exposure (2 to 3 weeks) to floodwaters (FEMA, 2006). The field survey revealed that some materials absorbed floodborne biological and chemical contaminants. However, it is not known at this time whether a shorter duration flood event would have altered the absorption rates of the contaminants significantly.

Building owners, design professionals, and local officials should consider potential exposure to floodborne contaminants when selecting flood damage-resistant materials. For example, Table 1 lists cast-in-place concrete, concrete block, and solid structural wood (e.g., 2x4s) as acceptable flood damage-resistant materials. However, experience has shown that buildings with these materials can be rendered unacceptable for habitation after being subjected to floodwaters with significant quantities of petroleum-based products such as home heating oil. Common cleaning and remediation practices do not reduce the off-gassing of volatile hydrocarbons from embedded oil residues to the 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.

6. Connectors and Fasteners

A “connector” typically refers to a manufactured device used to connect two or more building components. Joist hangers, post bases, hurricane ties and clips, and mud-sill anchors are examples of connectors. A “fastener” typically refers to a nail, screw, bolt, or anchor. Connectors and fasteners included in buildings in the SFHA must be made of flood damage-resistant materials to comply with the NFIP requirements.

Connectors and Fasteners

Specifications for connectors and fasteners 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.

Although Table 1 and Table 2 do not include connectors and fasteners, the performance of buildings exposed to flooding is partially a function of the connectors and fasteners used to connect the building components. When preservative-treated woods are used, particular attention to connectors and fasteners is required because some treatments are more corrosive than others, and corrosion can shorten the service life of connectors and fasteners. 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. Connectors and fasteners 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 I-Codes, recommends that stainless steel or hot-dip galvanized connectors and fasteners be used below the BFE in both inland (noncorrosive) and coastal (corrosive) areas. In coastal environments where airborne salts contribute to corrosion, corrosion-resistant connectors and fasteners are recommended throughout the building where they may be exposed. Where connectors and fasteners that provide the continuous load path are uncovered, they should be replaced with corrosion-resistant connectors and fasteners when found to be unsound or deficient. As a best practice, when uncovered connectors and fasteners are found to be unsound or deficient, designers should consider investigating whether the same conditions may exist in other parts of the building's load path.

NFIP Technical Bulletin 8

See NFIP Technical Bulletin 8, *Corrosion Protection for Metal Connectors and Fasteners in Coastal Areas*. Also see *Guidelines for Use of Alternative Preservative Treatments with Metal Connector Plates* (TPI/WTCA, 2007) for further guidance on metal plate-connected wood trusses manufactured with preservative-treated lumber.

7. Examples of Flood Damage-Resistant Construction Techniques

This section presents examples of flood damage-resistant construction techniques for various scenarios for buildings in Zone A (Section 7.1 of this Technical Bulletin), for buildings in Zone V (Section 7.2, of this Technical Bulletin), and for buildings designed and constructed for flood elevations above the minimum NFIP requirements (Section 7.3 of this Technical Bulletin).

7.1. Buildings in Zone A

The NFIP regulations require the lowest floor in buildings in Zone A to be at or above the BFE. Therefore, all materials below the lowest floor must be flood damage-resistant materials. Figure 1 illustrates a solid foundation wall (crawlspace) elevated to meet the minimum NFIP requirement. Figure 2 illustrates framed walls that may be used for enclosures below the BFE that are used only for parking of vehicles, building access, or storage.

To maximize the allowable use of enclosures below the BFE, it is a common practice to extend the foundation a full story, even though this 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 to reduce flood damage to the enclosed area in the event flooding exceeds the BFE.

NFIP Technical Bulletin 1

See NFIP Technical Bulletin 1, *Requirements for Flood Openings in Foundation Walls and Walls of Enclosures Below Elevated Buildings in Special Flood Hazard Areas*, for additional guidance on enclosures in Zone A below elevated buildings.

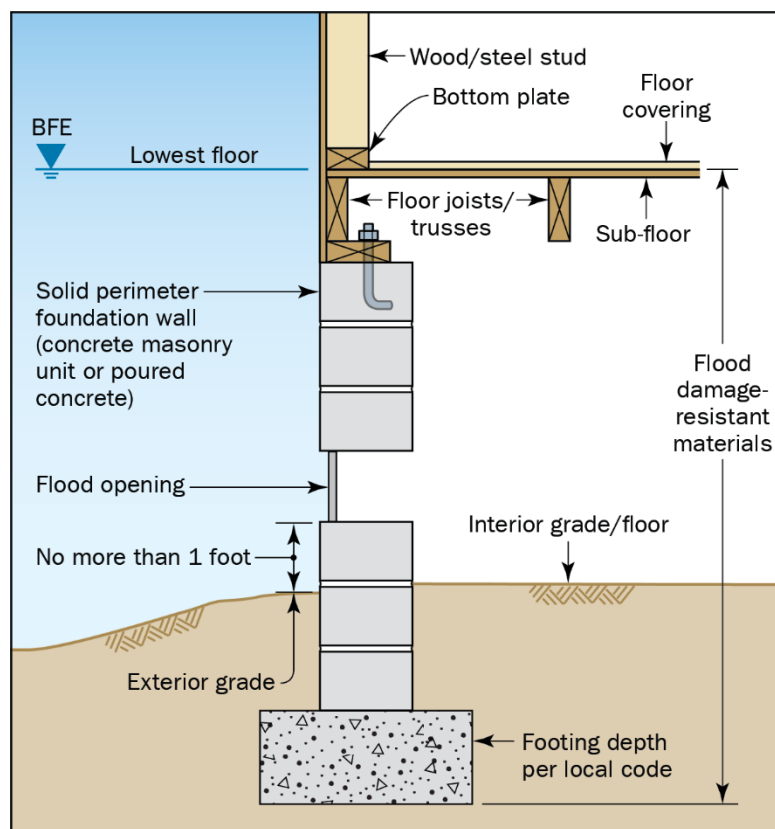


Figure 1: Building in Zone A elevated on solid foundation walls

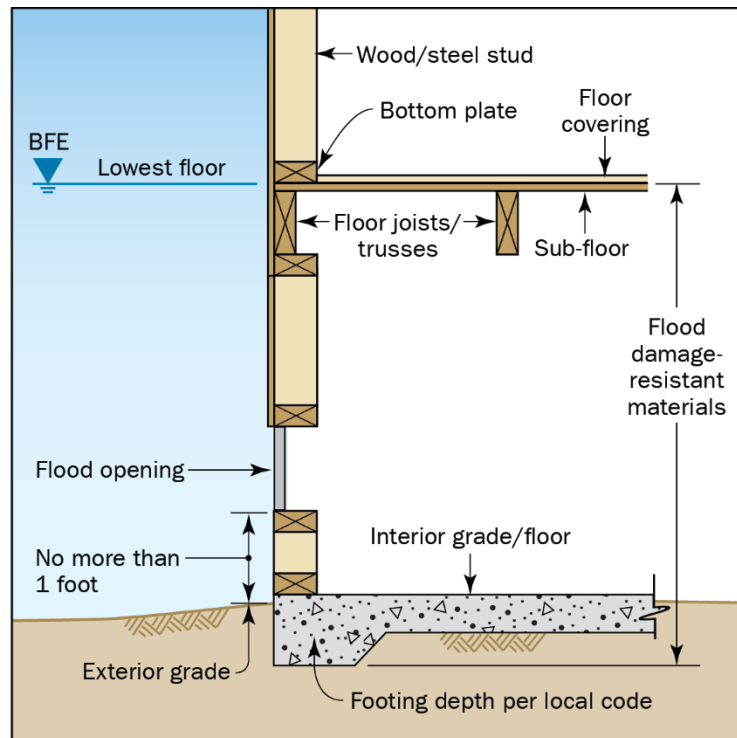


Figure 2: Framed enclosure in Zone A under elevated building

7.2. Buildings in Zone V

The NFIP regulations require the bottom of the lowest horizontal structural member of the lowest floor (usually the floor beam or girder) in buildings in Zone V to be at or above the BFE. Therefore, all materials below the bottom of these 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 that are selected, breakaway walls may remain in place during low-level floods and must be flood damage resistant so they can be readily cleaned and do not deteriorate over time due to wetting. Figure 3 illustrates the requirement.

NFIP Technical Bulletin 9

See NFIP Technical Bulletin 9, *Design and Construction Guidance for Breakaway Walls Below Elevated Coastal Buildings* for additional guidance on breakaway walls used to enclose areas under buildings in Zone V.

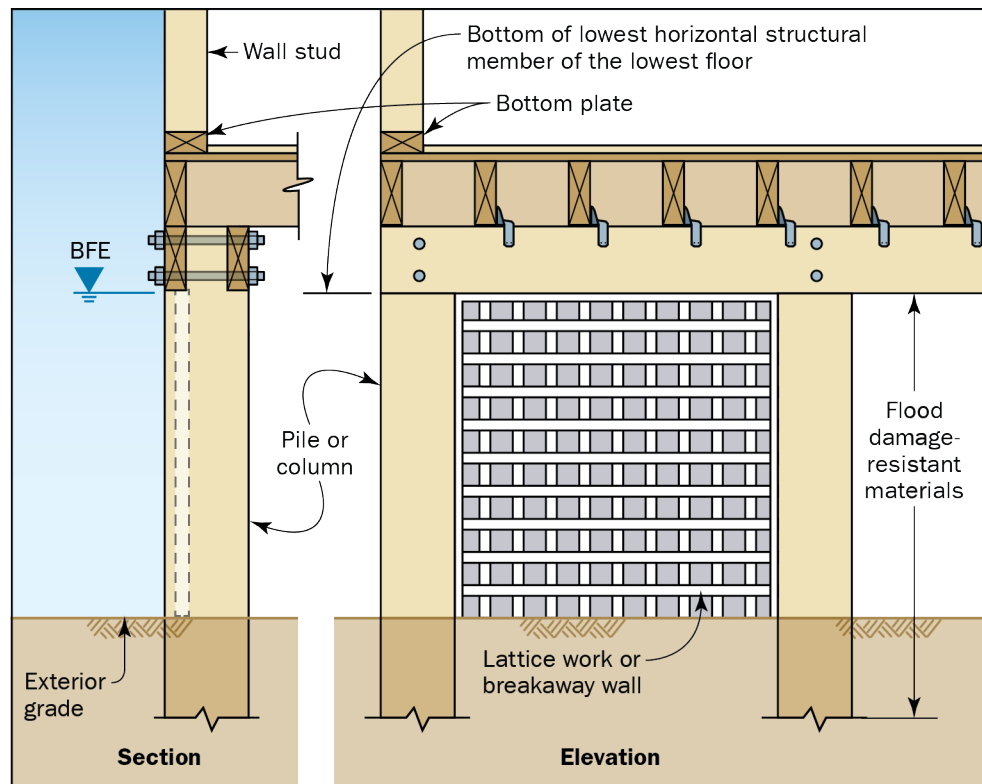


Figure 3: Flood damage-resistant building materials in Zone V

7.3 Buildings Designed and Constructed for Flood Elevations above the Minimum NFIP Requirements

Designers, builders, and homeowners can make decisions that further manage risks by increasing the level of hazard resistance for a building.

The NFIP requires elevation to a minimum of the BFE and the use of flood damage-resistant materials below the BFE. Storms can and do exceed the BFE. Elevating higher than the BFE can improve a building's resilience.

Some local and state regulations require freeboard, which is elevation above the BFE. When freeboard is required, the BFE plus freeboard is commonly called the design flood elevation (DFE). Freeboard benefits include protection when floods exceed the BFE and accommodating elevation increases in future map updates.

As shown in Figure 4, flood damage-resistant building materials and methods should be used below the higher of the DFE or the top of the lowest floor and for wall construction and floor finishes sitting directly on the lowest floor.

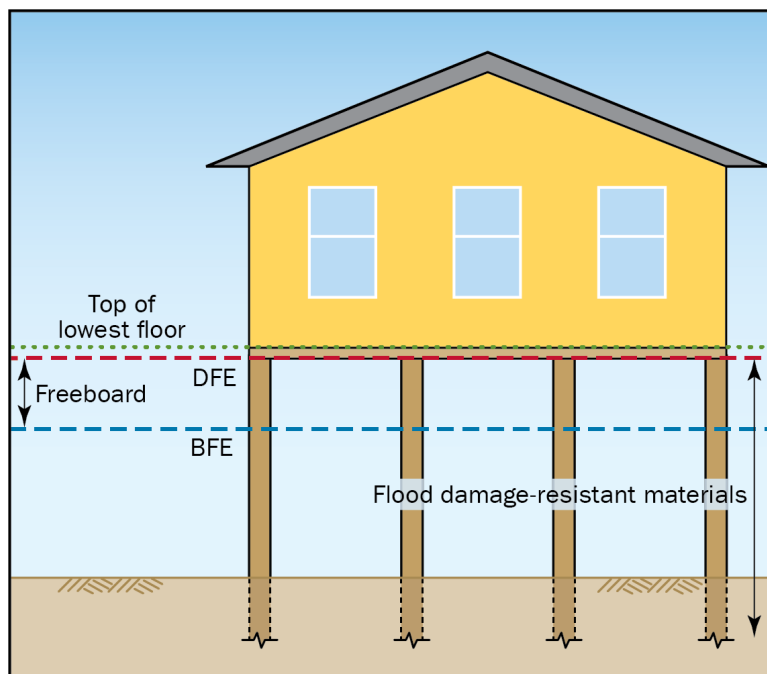


Figure 4: Flood damage-resistant building materials when freeboard is required

Recovery Advisory after Hurricane Ian

See DR-4673-FL RA 1, *Designing for Flood Levels Above the Minimum Required Elevation After Hurricane Ian, Recovery Advisory 1* (FEMA, 2023) for additional information on designing for flood levels above the minimum required elevation.

8. Additional Uses of Flood Damage-Resistant Materials

This section describes the use of flood damage-resistant materials in dry floodproofing (Section 8.1 of this Technical Bulletin), accessory structures (Section 8.2 of this Technical Bulletin), and wet floodproofing (Section 8.3 of this Technical Bulletin).

8.1. Dry Floodproofing

The NFIP requires the use of flood damage-resistant materials in the interior of dry floodproofed areas of non-residential and mixed-use buildings where seepage could collect up to at least 4 inches within 24 hours (substantially impermeable) above the floor. Because floodwaters can and at times do exceed the expected flood level, a recommended best practice is to use flood damage-resistant materials on the interior of the dry floodproofed areas up to the elevation of the dry floodproofing to reduce flood damage where the dry floodproofing level is exceeded and to expedite reuse of the building.

NFIP Technical Bulletin 3

See NFIP Technical Bulletin 3, *Requirements for the Design and Certification of Dry Floodproofed Non-Residential and Mixed Used Buildings Located in Special Flood Hazard Areas*, for additional guidance on dry floodproofing requirements.

8.2. Accessory Structures

Under the NFIP, accessory structures are regulated as non-residential structures, and the elevation and dry floodproofing requirements for non-residential structures apply to them. Recognizing that the inherent design and function of certain accessory structures may mean that the structures have low damage potential, FEMA Policy #104-008-03, *Floodplain Management Requirements for Agricultural Structures and Accessory Structures* (FEMA, 2020), allows the use of flood protection methods other than elevation and dry floodproofing of accessory structures in some situations.

FEMA P-2140, *Floodplain Management Bulletin: Floodplain Management Requirements for Agricultural Structures and Accessory Structures* (FEMA, 2021), defines accessory structures for floodplain management purposes as structures on the same parcel of property as the principal structure with a use that is incidental to the use of the principal structure. FEMA P-2140 states further that accessory structures must be used for parking or storage and describes the circumstances under which communities may authorize wet floodproofed accessory structures by permit (based on size) and when communities must use variance procedures to consider wet floodproofing. FEMA P-2140 includes decision charts that can be used to determine whether proposed projects are considered accessory structures and whether they may be wet floodproofed. 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.

8.3. Wet Floodproofing

Wet floodproofing is a method of reducing damage that typically involves three elements: allowing floodwaters to enter and exit a structure to minimize damage, using flood damage-resistant materials, and elevating utility service and equipment. When a building is retrofitted to be wet floodproofed, materials that are not flood damage-resistant that are below the BFE should be removed and replaced with flood damage-resistant materials to reduce the cost of repair and expedite recovery.

When compliance with the NFIP is required, wet floodproofing is not allowed as an alternative to complying with the lowest floor elevation requirements for new or substantially improved residential buildings (or dry floodproofing of nonresidential buildings in Zone A). The exception is accessory structures, as discussed in Section 8.2 of this Technical Bulletin. When compliance with the NFIP is not required, wet floodproofing may also be used to voluntarily retrofit buildings provided the building is not less compliant with the requirements that were in effect when the building was constructed.

Figure 5 illustrates suggested retrofitting of interior walls in an existing building. However, note that the techniques illustrated in Figure 5 cannot be used to bring a substantially damaged or substantially improved building into compliance with the NFIP.

When compliance with the NFIP is required, the use of wet floodproofing measures is limited to enclosures below elevated buildings and attached garages. These areas are to be used for parking of vehicles, building access, or storage. Areas below the BFE must be constructed with flood damage-resistant materials, and flood openings to allow for the automatic entry and exit of flood waters must be provided in Zone A. Areas below the lowest floor of a building in Zone V must be free-of-obstruction or constructed of breakaway walls using flood damage-resistant materials.

NFIP Technical Bulletin 7

See NFIP Technical Bulletin 7, *Wet Floodproofing Requirements and Limitations*, for additional information on wet floodproofing.

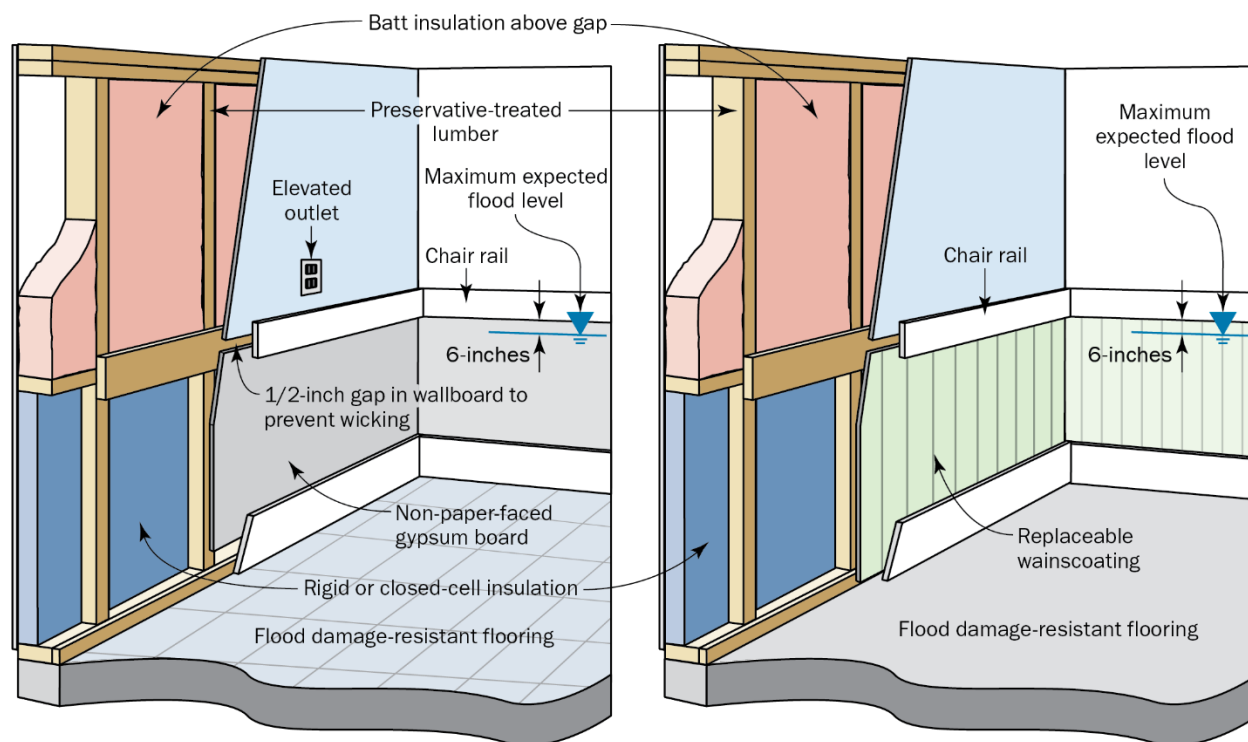


Figure 5: Partial wet floodproofing technique in finished wall construction when NFIP compliance is not required

9. Buildings Outside Special Flood Hazard Areas

FEMA reports that up to 40 % of NFIP flood insurance claims are paid on buildings that are outside the mapped SFHA in low- to moderate-risk areas. The reasons include maps that no longer accurately reflect the actual risk during a base flood event 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. Owners should also consider incorporating flood damage-resistant materials when:

- Replacing wooden floorboards and carpet with tile, vinyl, rubber, or other flood-resistant materials and using throw rugs
- Replacing walls with flood damage-resistant materials
- Replacing wooden doors and window frames with flood damage-resistant materials
- Elevating electrical system components
- Relocating utilities and service equipment, including appliances, to a higher location

10. References and Resources

This section lists the cited references (Section 10.1) and resources with information on flood damage-resistant materials (Section 10.2). See Technical Bulletin 0 for additional resources.

10.1. References

Algan, H. and Wendt, R. 2004. *Field Testing of Flood-Damage-Resistant Residential Envelope Systems, Summary Report*. Oak Ridge National Laboratory. Available at <https://info.ornl.gov/sites/publications/Files/Pub57489.pdf>.

ASCE/SEI (American Society of Civil Engineers / Structural Engineering Institute). 2014. *ASCE/SEI 24-14, Flood Resistant Design and Construction*. Available at <https://www.asce.org/>.

ASTM (ASTM International). 2024a. ASTM E3075, *Standard Test Method for Water Immersion and Drying for Evaluation of Flood Damage Resistance*. Available at <https://www.astm.org/e3075-18.html>.

ASTM. 2024b. ASTM E3369, *Standard Specification for Determining the Flood Damage Resistance Rating of Building Materials*. Available at <https://www.astm.org/e3369-24.html>.

FEMA (Federal Emergency Management Agency). Various. NFIP Technical Bulletins. Current editions available at <https://www.fema.gov/emergency-managers/risk-management/building-science/national-flood-insurance-technical-bulletins>:

- Technical Bulletin 0, *User's Guide to Technical Bulletins*.
- Technical Bulletin 1, *Requirements for Flood Openings in Foundation Walls and Walls of Enclosures*.
- Technical Bulletin 3, *Requirements for the Design and Certification of Dry Floodproofed Non-Residential and Mixed-Use Buildings*.

- Technical Bulletin 7, *Wet Floodproofing Requirements and Limitations*.
- Technical Bulletin 8, *Corrosion Protection for Metal Connectors and Fasteners in Coastal Areas*.
- Technical Bulletin 9, *Design and Construction Guidance for Breakaway Walls Below Elevated Buildings Located in Coastal High Hazard Areas*.

FEMA. 2006. FEMA 549, *Hurricane Katrina in the Gulf Coast: Mitigation Assessment Team Report*. Available at https://www.preventionweb.net/files/1543_549cvrtoc1.pdf.

FEMA. 2010. FEMA P-758, *Substantial Improvement/Substantial Damage Desk Reference*. Available at https://www.fema.gov/sites/default/files/2020-08/fema_p_758_complete_r3_0.pdf.

FEMA. 2018. FEMA 213, *Answers to Questions About Substantially Damaged Improved/Damaged Buildings*. Available at https://www.fema.gov/sites/default/files/2020-07/fema_p213_08232018.pdf.

FEMA. 2020. FEMA Policy #104-008-03, *Floodplain Management Requirements for Agricultural Structures and Accessory Structures*. Available at <https://www.fema.gov/assistance/public/policy-guidance-fact-sheets/floodplain-management-requirements-agricultural-and-accessory-structures>.

FEMA. 2021. FEMA P-2140, *Floodplain Management Requirements for Agricultural Structures and Accessory Structures*. Version 1.1. Available at <https://www.fema.gov/assistance/public/policy-guidance-fact-sheets/floodplain-management-requirements-agricultural-and-accessory-structures>.

FEMA. 2023. DR-4673-FL RA 1, *Designing for Flood Levels Above the Minimum Required Elevation After Hurricane Ian*. Available at https://www.fema.gov/sites/default/files/documents/fema_mat-hurricane-ian-recovery-advisory-1.pdf.

ICC (International Code Council). *International Codes*. Available at <https://codes.iccsafe.org/>.

- ICC. 2018. *2018 International Building Code*.
- ICC. 2021. *2021 International Building Code*.
- ICC. 2024. *2024 International Building Code*.
- ICC. 2018. *2018 International Residential Code*.
- ICC. 2021. *2021 International Residential Code*.
- ICC. 2024. *2024 International Residential Code*.

NFPA 70. *National Electrical Code*. 2023. National Fire Protection Association. Available at <https://www.nfpa.org/>.

TPI/WTCA (Truss Plate Institute / Wood Truss Council of America). 2007. *TPI/WTCA Guidelines for Use of Alternative Preservative Treatments with Metal Connector Plates*. Available at https://www.sbcindustry.com/sites/default/files/uploads/attachments/field_collection/223/ptwguidelines.pdf.

USACE (U.S. Army Corps of Engineers). 1995. EP 1165-2-314, *Flood Proofing Regulations*. https://cdn2.hubspot.net/hub/187435/file-40740778-pdf/docs/usarmycoe_flood_proofing_regulations.pdf.

10.2. Resources

ASCE. 2022. ASCE 7-22, *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*. Available at <https://www.asce.org/>.

Brick Institute of America. n.d. “Technical Notes.” Available at <https://www.gobrick.com/resources/technical-notes>.

FEMA. 2013. FEMA P-936, *Floodproofing Non-Residential Buildings*. Available at https://www.fema.gov/sites/default/files/2020-07/fema_p-936_floodproofing_non-residential_buiildings_110618pdf.pdf.

FEMA. 2015. *Highlights of ASCE 24-14 Flood Resistant Design and Construction*. Available at https://www.fema.gov/sites/default/files/2020-07/asce24-14_highlights_jan2015.pdf.

Simpson Strong-Tie. 2008. *Technical Bulletin: Preservative-Treated Wood*.

USACE. 1984. *Flood Proofing Systems and Techniques: Examples of Flood Proofed Structures in the United States*.

WFCA (World Floor Covering Association). n.d. “Latest News.” Available at <https://wfca.org/>.

WTCA (Wood Truss Council of America). 2005. *The Load Guide: Guide to Good Practice for Specifying and Applying Loads to Structural Building Components*. Available at <https://www.sbcmag.info/sites/default/files/0506%20wtcaupdate.pdf>.

Questions and Further Information

Questions and further information about the flood damage-resistant materials requirement should be directed to the appropriate local official, NFIP State Coordinating Office, or FEMA Regional Office.

Appendix A: Detailed Comparison of Building Codes and Standards with NFIP Requirements

This appendix of the National Flood Insurance Program’s Technical Bulletin 2, *Flood Damage-Resistant Materials Requirements*, contains Tables A-1, A-2, and A-3. The tables summarize the 2024 IRC, IBC, and IEBC requirements related to flood damage-resistant materials, notes changes from the 2018 and 2021 editions, and compares the IRC, IBC, and IEBC provisions to the NFIP requirements. Subsequent editions of the IRC, IBC, and IEBC should include comparable requirements.

The IRC requirements related to the use of flood damage-resistant materials are summarized in Table A-1 with a comparison to NFIP requirements.

Table A-1: Comparison of Selected 2024 IRC Requirements with NFIP Requirements

Topic	Summary of Selected 2024 IRC Requirements and Changes from 2021 and 2018 Editions	Comparison with NFIP Requirements
Flood damage-resistant materials	Section R306.1.8 Flood-resistant materials. Requires materials below the required elevation to conform to the requirements of NFIP Technical Bulletin 2, <i>Flood Damage-Resistant Materials Requirements</i>. The required elevation is BFE plus 1 foot or design flood elevation (DFE), whichever is higher. <u>Change from 2021 to 2024:</u> Renumbered Section R322 to Section R306. <u>Change from 2018 to 2021:</u> No change.	Exceeds NFIP 44 CFR Section 60.3(a)(3) by requiring flood damage-resistant materials to extend higher than the BFE.
Accessory structures and detached garages	Section R306.2.1 Elevation Requirements and Section R306.3.2 Elevation Requirements. Permits certain accessory structures and detached garages below the required elevation provided they comply with specific limitations, including the requirement for use of flood damage-resistant materials that comply with Section R306.1.8. <u>Change from 2021 to 2024:</u> Added specific provisions for accessory structures and detached garages.	Exceeds NFIP 44 CFR Section 60.3(a)(3) by requiring flood damage-resistant materials to extend higher than the BFE.
Appendices: Manufactured housing, light straw-clay construction, strawbale construction, and existing dwellings	2024 Appendices. Appendices are not mandatory unless specifically adopted. IRC appendices that refer to Section R306 for compliance when structures are located in flood hazard areas, including compliance with Section R306.1.8 for flood damage-resistant materials, include:	Exceeds NFIP 44 CFR Section 60.3(a)(3) by requiring flood damage-resistant materials to extend higher than the BFE.

Topic	Summary of Selected 2024 IRC Requirements and Changes from 2021 and 2018 Editions	Comparison with NFIP Requirements
	Appendix BA Manufactured Housing Used as Dwellings Appendix BI Light Straw-Clay Construction Appendix BJ Strawbale Construction Appendix BO Existing Buildings and Structures	

The IBC and ASCE 24 requirements related to the use of flood damage-resistant materials are summarized in Table A-2 with a comparison to NFIP requirements.

Table A-2: Comparison of Selected 2024 IBC and ASCE 24-14 Requirements with NFIP Requirements

Topic	Summary of Selected 2024 IBC/ASCE 24-14 Requirements and Changes from 2021 and 2018 IBC	Comparison with NFIP Requirements
Definition	2024 IBC Section 202 Definitions. Defines flood damage-resistant materials. <u>Change from 2021 to 2024 IBC:</u> No change. <u>Change from 2018 to 2021 IBC:</u> No change.	Exceeds NFIP 44 CFR Section 60.3(a)(3) by defining the term.
Interior finishes	2024 IBC Section 802.4 Applicability. Requires interior finishes, trim, and decorative materials that are used below the required elevation to be flood damage-resistant materials. The required elevation is at least the BFE plus 1 foot, or DFE, and may be higher depending on building occupancy. <u>Change from 2021 to 2024 IBC:</u> No change. <u>Change from 2018 to 2021 IBC:</u> No change.	Exceeds NFIP 44 CFR Section 60.3(a)(3) by requiring flood damage-resistant materials to extend higher than the BFE.
Exterior walls	2024 IBC Section 1402.9 Flood resistance. Requires exterior walls below the required elevation to be constructed of flood damage-resistant materials. The required elevation is at least the BFE plus 1 foot, or DFE, and may be higher depending on building occupancy. <u>Change from 2021 to 2024 IBC:</u> No change. <u>Change from 2018 to 2021 IBC:</u> No change.	Exceeds NFIP 44 CFR Section 60.3(a)(3) by requiring flood damage-resistant materials to extend higher than the BFE.

Topic	Summary of Selected 2024 IBC/ASCE 24-14 Requirements and Changes from 2021 and 2018 IBC	Comparison with NFIP Requirements
Flood-resistant construction	2024 IBC Section 1612.2 Design and construction. Requires buildings and structures in flood hazard areas to be designed and constructed in accordance with ASCE 24. <u>Change from 2021 to 2024 IBC:</u> Moved reference to applicable standards for elevators, escalators, and conveying systems to Section 1612.2 from different section. <u>Change from 2018 to 2021 IBC:</u> No change.	Exceeds NFIP 44 CFR Section 60.3(a)(3) by requiring that flood damage-resistant materials extend higher than the BFE.
Flood damage-resistant materials	2024 IBC Appendix G, Flood- Resistant Construction: Section G104.1 Permit applications. Requires development to be designed and constructed with materials to minimize flood damage. Section G106.4 Functionally dependent facilities. Requires that evaluation of variances for functionally dependent facilities consider the use of materials to minimize flood damage. Section G114.5 Utility and Miscellaneous Group U; Flood-damage-resistant materials. Requires the use of flood damage-resistant materials below the required elevation for Utility and Miscellaneous Group U structures. <u>Change from 2021 to 2024 IBC:</u> No change. <u>Change from 2018 to 2021 IBC:</u> No change.	Exceeds NFIP 44 CFR Section 60.3(a)(3) by requiring that flood damage-resistant materials extend higher than the BFE.
Flood damage-resistant materials	ASCE 24-14 Chapter 5 Materials, Section 5.1 General. Requires use of flood damage-resistant materials below the required elevation and includes additional detailed requirements for specific materials. The required elevation depends on the Flood Design Class assigned to buildings. ASCE 24-14 Commentary Chapter C.5 Materials, Section C5.1 General. References FEMA Technical Bulletin 2 (2008) as a key source of information for selection of flood damage-resistant materials.	Exceeds NFIP 44 CFR Section 60.3(a)(3) by requiring that flood damage-resistant materials extend higher than the BFE.

The IEBC requirements related to the use of flood damage-resistant materials are summarized in Table A-3 with a comparison to NFIP requirements.

Table A-3: Comparison of Selected 2024 IEBC Requirements with NFIP Requirements

Topic	Summary of Selected 2024 IEBC Requirements and Changes from 2021 and 2018 Editions	Comparison with NFIP Requirements
Determination of substantial improvement / substantial damage	Section 104.3.1 Determination of substantially improved or substantially damaged existing buildings and structures in flood hazard areas. Requires the code official to determine if proposed work constitutes substantial improvement or repair of substantial damage. Compliance with the flood resistant requirements of Section 1612 of the IBC, or Section R306 of the IRC, as applicable, is required when the work is determined to be a substantial improvement or repair of substantial damage. See Table A-1 for description of IRC Section R306.1.8 and Table A-2 for description of IBC Sections 802.4, 1612, and 1402.9. <u>Change from 2021 to 2024 IEBC:</u> Renumbered Section 104.2.1 to Section 104.3.1. <u>Change from 2018 to 2021 IEBC:</u> No change.	Exceeds NFIP 44 CFR Section 60.3(a)(3) by requiring flood damage-resistant materials to extend higher than the BFE when compliance is required.
Repairs	Section 401.3 Flood hazard areas. Section 405.2.6 Flood hazard areas. Requires substantially damaged buildings to comply with the flood-resistant requirements of Section 1612 of the IBC, or Section R306 of the IRC, as applicable. <u>Change from 2021 to 2024 IEBC:</u> No change. <u>Change from 2018 to 2021 IEBC:</u> No change.	Exceeds NFIP 44 CFR Section 60.3(a)(3) by requiring flood damage-resistant materials to extend higher than the BFE when compliance is required.
Prescriptive requirements for additions, alterations, and historic buildings	Section 502.2 Flood hazard areas. (Additions) Section 503.2 Flood hazard areas. (Alterations) Section 507.2 Flood hazard areas, [Historic Buildings] Requires buildings to comply with the flood-resistant requirements of Section 1612 of the IBC, or Section R306 of the IRC, as applicable, when additions, alterations, and work on historic buildings are determined to be substantial improvements. Specifies that new, replacement, and raised or extended foundations must comply with the flood-resistant requirements of Section 1612 of the IBC, or Section R306 of the IRC, as applicable. Specifies requirements for additions that are not determined to be substantial improvements so as not to create or extend nonconformities. <u>Change from 2021 to 2024 IEBC:</u> No change. <u>Change from 2018 to 2021 IEBC:</u> No change.	Exceeds NFIP 44 CFR Section 60.3(a)(3) by requiring flood damage-resistant materials to extend higher than the BFE when compliance is required.

Topic	Summary of Selected 2024 IEBC Requirements and Changes from 2021 and 2018 Editions	Comparison with NFIP Requirements
Alterations – Level 1, Level 2, and Level 3	Section 701.3 Flood hazard areas. [Level 1] Section 801.2 Alteration level 1 compliance. [Level 2] Section 901.2 Compliance. [Level 3] Requires buildings to comply with the flood-resistant requirements of Section 1612 of the IBC, or Section R306 of the IRC, as applicable, when Level 1 alterations are determined to be substantial improvements. Level 2 alterations must comply with Level 1 requirements. Level 3 alterations must comply with Level 1 and Level 2 requirements. <u>Change from 2021 to 2024 IEBC:</u> No change. <u>Change from 2018 to 2021 IEBC:</u> No change.	Exceeds NFIP 44 CFR Section 60.3(a)(3) by requiring flood damage-resistant materials to extend higher than the BFE when compliance is required.
Additions	Section 1103.3 Flood hazard areas. Specifies when horizontal additions must comply and when the base buildings must be brought into compliance with the flood-resistant requirements of Section 1612 of the IBC, or Section R306 of the IRC, as applicable. Specifies that when vertical additions are substantial improvements, the base buildings must be brought into compliance with the flood-resistant requirements of Section 1612 of the IBC, or Section R306 of the IRC, as applicable. Specifies that new, replacement, and raised or extended foundations must comply with the flood-resistant requirements of Section 1612 of the IBC, or Section R306 of the IRC, as applicable. <u>Change from 2021 to 2024 IEBC:</u> Added requirements for horizontal additions that are not substantial improvements. Modified to require all new, replacement, and raised or extended foundations to comply. <u>Change from 2018 to 2021 IEBC:</u> No change.	Exceeds NFIP 44 CFR Section 60.3(a)(3) by requiring flood damage-resistant materials to extend higher than the BFE when compliance is required.
Historic buildings	Section 1201.4 Flood hazard areas. Requires certain historic buildings, when work on them constitutes substantial improvement, to comply with the flood-resistant requirements of Section 1612 of the IBC, or Section R306 of the IRC, as applicable. <u>Change from 2021 to 2024 IEBC:</u> No change. <u>Change from 2018 to 2021 IEBC:</u> No change.	Exceeds NFIP 44 CFR Section 60.3(a)(3) by requiring flood damage-resistant materials to extend higher than the BFE when compliance is required.

Topic	Summary of Selected 2024 IEBC Requirements and Changes from 2021 and 2018 Editions	Comparison with NFIP Requirements
Performance requirements for alterations, additions, change or occupancy, and historic buildings.	Section 1303.1.3 Compliance with flood provisions. Requires buildings to comply with the flood-resistant requirements of Section 1612 of the IBC, or Section R306 of the IRC, as applicable, when additions, alterations, and work on historic buildings are determined to be substantial improvements. Specifies requirements for additions that are not determined to be substantial improvements so as not to create or extend nonconformities. <u>Change from 2021 to 2024 IEBC:</u> Added requirements for horizontal additions that are not substantial improvements. <u>Change from 2018 to 2021 IEBC:</u> No change.	Exceeds NFIP 44 CFR Section 60.3(a)(3) by requiring flood damage-resistant materials to extend higher than the BFE when compliance is required.
Relocated or moved buildings	Section 1402.6 Flood hazard areas. Requires structures relocated or moved into flood hazard areas to comply with the flood-resistant requirements of Section 1612 of the IBC, or Section R306 of the IRC, as applicable. <u>Change from 2021 to 2024 IEBC:</u> No change. <u>Change from 2018 to 2021 IEBC:</u> No change.	Exceeds NFIP 44 CFR Section 60.3(a)(3) by requiring flood damage-resistant materials to extend higher than the BFE when compliance is required.