



# 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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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 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
<b>Structural Materials (floor slabs, beams, subfloors, framing, and interior/exterior sheathing)</b>							
Preservative-treated, Borate <sup>2</sup>	■	■	■				
Exterior grade/Exposure1 (WBP – weather and boil proof)	■	■		■			
All other types	■	■					■
<b>Recycled plastic lumber (RPL)</b>							
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	■				■		
<b>Stone</b>							
Natural or artificial non-absorbent solid or veneer, waterproof grout	■	■	■				
All other applications		■				■	
<b>Structural Building Components</b>							
Floor trusses, wood, solid (2x4s), decay-resistant or preservative-treated	■	■		■			
Floor trusses, steel <sup>3</sup>	■		■				
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 <sup>3</sup>		■	■				
I-joists	■					■	
Wall panels, plywood, exterior grade or preservative-treated		■		■			
Wall panels, OSB, exterior grade or edge-swell resistant		■				■	
Wall panels, steel <sup>3</sup>		■		■			

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
<b>Structural Materials (floor slabs, beams, subfloors, framing, and interior/exterior sheathing)</b>							
Wood							
Solid, standard, structural (2x4s)		■		■			
Solid, standard, finish/trim		■			■		
Solid, decay-resistant <sup>4</sup>	■	■	■				
Solid, preservative-treated, ACQ or C-A		■		■			
Solid, preservative-treated, Borate <sup>2</sup>		■		■			
<b>Finish Materials (floor coverings, wall and ceiling finishes, insulation, cabinets, doors, partitions, and windows)</b>							
Asphalt tile <sup>5</sup>							
With asphaltic adhesives	■				■		
All other types	■						■
Cabinets, built-in							
Wood		■				■	
Particle board		■					■
Metal <sup>3</sup>		■		■			
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 <sup>3</sup>		■		■			
Metal, wood core <sup>3</sup>		■		■			
Metal, foam-filled core <sup>3</sup>		■		■			
Fiberglass, wood core		■		■			
Epoxy, formed-in-place	■		■				

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

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	Floors	Walls/ Ceilings	Acceptable		Unacceptable		
			5	4	3	2	1
<b>Finish Materials (floor coverings, wall and ceiling finishes, insulation, cabinets, doors, partitions, and windows)</b>							
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 <sup>3</sup>		■		■			
Paint							
Polyester-epoxy and other oil-based waterproof types		■		■			
Latex		■		■			
Partitions, folding							
Wood		■				■	
Metal <sup>3</sup>		■		■			
Fabric-covered		■					■
Partitions, stationary (free-standing)							
Wood frame		■		■			
Metal <sup>3</sup>		■		■			
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
<b>Finish Materials (floor coverings, wall and ceiling finishes, insulation, cabinets, doors, partitions, and windows)</b>							
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 tiles <sup>5</sup>							
With chemical-set adhesives <sup>6</sup>	■		■				
All other applications	■						■
Silicone floor, formed-in-place	■		■				
Steel (panels, trim, tile)							
With waterproof adhesives <sup>3</sup>		■	■				
With non-waterproof adhesives		■				■	
Terrazo	■			■			
Vinyl asbestos tile (semi-flexible vinyl) <sup>5</sup>							
With asphaltic adhesives	■		■				
All other applications	■						■
Vinyl sheets or tiles (coated on cork or wood product backings)	■						■
Vinyl sheets or tiles (homogeneous) <sup>5</sup>							
With chemical-set adhesives <sup>6</sup>	■			■			
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	■					■	

FEMA Publications  
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Jessup, MD 20794

## Further Information

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

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Department of Energy. 2005. *Energy-Efficient Flood-Damage-Resistant Home Reconstruction*, ([http://www.ornl.gov/sci/res\\_buildings/FEMA-attachments/Flood\\_damage-reconstruction.pdf](http://www.ornl.gov/sci/res_buildings/FEMA-attachments/Flood_damage-reconstruction.pdf)).

FEMA. 1991. *Answers to Questions About Substantially Damaged Buildings*, FEMA 213.

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FEMA. 2006. *Mitigation Assessment Team Report: Hurricane Katrina in the Gulf Coast*, FEMA 549.

FEMA. 2007. *National Flood Insurance Program: Flood Insurance Manual*, Revised October 2007.

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Simpson Strong-Tie. 2008. *Technical Bulletin: Preservative-Treated Wood*, Simpson Strong-Tie T-PTWOOD08-R, July 2008 (<http://www.strongtie.com/ftp/bulletins/T-PTWOOD08-R.pdf>).

TPI/WTCA. 2004. *TPI/WTCA Guidelines for Use of Alternative Preservative Treatments with Metal Connector Plates*, updated June 4, 2007, (<http://www.sbcindustry.com/images/PTWGuidelines.pdf>).

U.S. Army Corps of Engineers. 1984. *Flood Proofing Systems and Techniques*, U.S. Army Corps of Engineers, December 1984.

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.

**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.

**Mitigation Directorate** — The component of FEMA directly responsible for administering the flood hazard identification and floodplain management aspects 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, A1-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.