Can I Dry Floodproof my Building?

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Abstract

- FEMA Technical bulletin 3-93 outlining Non-Residential Floodproofing — Requirements and Certification is more than 20 years old. This session will focus on recent requirements outlined in the Flood Insurance Manual, guidance from FEMA publication (FEMA P-936), standards (ASCE 24, ANSI/FM Approval 2510), and other initiatives that building owners should consider when evaluating floodproofing as a proposed mitigation measure to reduce their flood risk. Navigating the various requirements can be cumbersome and overwhelming to a building owner and/or design professional. **We will explore various resources and best practices to effectively implement floodproofing measures.**
Agenda

• Key terms
• Walk through/navigate
  – Regulations
  – Codes & Standards
  – Flood Insurance Requirements
  – Guidance/Best Practices
• Lessons Learned
Key Terms – 44 CFR

- Floodproofing (44 CFR 59.1) means any combination of structural and non-structural additions, changes, or adjustments to **structures** which reduce or eliminate flood damage to real estate or improved real property, water and sanitary facilities, structures and their contents.
§60.3 Flood plain management criteria for flood-prone areas
  (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 accepted standards of practice for meeting the applicable provisions of paragraph (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 under § 59.22(a)(9)(iii);
§60.3(c)(3)(ii)
- Require that all new construction and substantial improvements of nonresidential structures within Zones A1–30, AE and AH zones on the community’s firm 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.

§60.3(c)(8)(ii)
- Require within any AO zone on the community’s FIRM that all *new construction and substantial improvements* of nonresidential structures together with attendant utility and sanitary facilities be completely floodproofed to that level to meet the floodproofing standard specified in §60.3(c)(3)(ii).
1612.5 Flood hazard documentation. The following documentation shall be prepared and sealed by a registered design professional and submitted to the building official:

- For construction in flood hazard areas not subject to high-velocity wave action:
  - The elevation of the lowest floor, including the basement, as required by the lowest floor elevation inspection in Section 110.3.3.
  - For fully enclosed areas below the design flood elevation where provisions to allow for the automatic entry and exit of floodwaters do not meet the minimum requirements in Section 2.6.2.1 of ASCE 24, construction documents shall include a statement that the design will provide for equalization of hydrostatic flood forces in accordance with Section 2.6.2.2 of ASCE 24.
  - For dry floodproofed nonresidential buildings, construction documents shall include a statement that the dry floodproofing is designed in accordance with ASCE 24.

- 2009 and subsequent I-Code flood provisions meet or exceed NFIP
- ASCE 24 incorporated since 2000 edition
Key Terms – ASCE 24

• Dry Floodproofing — floodproofing method used to render a structure envelope substantially impermeable to the entrance of floodwater.

• Floodproofing — any combination of structural or nonstructural adjustments, changes, or actions that reduce or eliminate flood damage to a structure, contents, and attendant utilities and equipment.

• Human Intervention — required presence and active involvement of people to enact a floodproofing measure prior to flooding.
Key Terms – ASCE 24

• Shield — removable or permanent substantially impermeable protective cover for an opening in a structure below the DFE, used in floodproofing the structure.

• Substantially Impermeable — use of flood damage-resistant materials and techniques for dry floodproofing portions of a structure, which result in a space free of through cracks, openings, or other channels that permit unobstructed passage of water and seepage during flooding, and which result in a maximum accumulation of 4 in. of water.

• Wet Floodproofing — floodproofing method that relies on the use of flood-damage-resistant materials and construction techniques to minimize flood damages to areas below the DFE of a structure intentionally allowed to flood.
ASCE 24-14 versus 24-05

- ASCE 7 Classification of Structures for Flood-Resistant Design and Construction
- Flood Design Class of Buildings and Structures
- Defines Mixed Use
- 500-year flood elevation requirement for Flood Design Class 4 buildings
- Additional Chapter 6 Commentary
• Chapter 6
  – Dry Floodproofing Limitations
    • where flood velocities adjacent to the structure are less than or equal to 5 ft/s during the design flood
    • if human intervention is proposed, where conformance with the limitations of Section 6.2.3 is provided
  – Dry Floodproofing Requirements
    • shall be designed and constructed to resist hydrostatic, hydrodynamic, and other flood-related loads, including the effects of buoyancy
    • protect against erosion and local scour
    • have at least one door satisfying building code egress requirements for an emergency escape and rescue opening
Chapter 6

Limits on Human Intervention

- The flood warning time shall be a minimum of 12 hours
- Where removable shields are to be used, a flood emergency plan shall be approved by the authority having jurisdiction
  - conditions activating installation
  - storage locations, maintenance, and method of installation of shields
  - periodic practice of installing, testing sump pumps, and other required measures
  - inspecting necessary material and equipment to implement
  - posted permanently in at least two locations within the structure
Table 6-1 Minimum Elevation of Floodproofing—Flood Hazard Areas Other Than Coastal High Hazard Areas, Coastal A Zones, and High Risk Flood Hazard Areas

<table>
<thead>
<tr>
<th>Flood Design Class&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Minimum Elevation of Floodproofing&lt;sup&gt;c&lt;/sup&gt; Relative to Base Flood Elevation (BFE) or Design Flood Elevation (DFE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>BFE + 1 ft or DFE, whichever is higher</td>
</tr>
<tr>
<td>2&lt;sup&gt;d&lt;/sup&gt;</td>
<td>BFE + 1 ft or DFE, whichever is higher</td>
</tr>
<tr>
<td>3&lt;sup&gt;d&lt;/sup&gt;</td>
<td>BFE + 1 ft or DFE, whichever is higher</td>
</tr>
<tr>
<td>4&lt;sup&gt;d&lt;/sup&gt;</td>
<td>BFE + 2 ft or DFE, or 500-year flood elevation, whichever is higher</td>
</tr>
</tbody>
</table>

<sup>a</sup>Dry floodproofing is not allowed in Coastal High Hazard Areas, Coastal A Zones, and other High Risk Flood Hazard Areas.

<sup>b</sup>See Table 1-1 for Flood Design Class descriptions.

<sup>c</sup>Wet or dry floodproofing shall extend to the same level.

<sup>d</sup>Dry floodproofing of residential buildings and residential portions of mixed-use buildings shall not be permitted.
Key Terms – ANSI 2510 (FM Approvals 2510)

- Opening Barrier – any device capable of preventing flood water from passing through an opening in a structure. Opening barriers are permanent or contingent and operate as automatic or manual.

- Perimeter Barrier – a temporary emergency structure which, when deployed, is intended to protect an area surrounding an occupancy from riverine flood conditions.
ANSI/FM Approvals 2510

- Temporary Perimeter Flood Barriers
- Opening Barriers
- Backwater Valves
- Flood Abatement Pumps
The specifications for floodproofing ensure that the building is **watertight**, its floodproofed walls will **not collapse**, and the floor at the base of the floodproofed walls will resist flotation during flooding conditions.

For residential buildings, the building must be watertight **without human intervention**.

In order to be eligible for lower rates, the insured must have a registered professional engineer or architect certify that the building has been floodproofed to **at least 1 foot above the BFE**.

This **certification** must be submitted with the Flood Insurance Application, and must be accompanied by at least 2 photographs. For non-residential buildings, the photographs must show the floodproofing measures in place.

All non-residential floodproofed buildings must follow **submit-for-rate** procedures.
In order to ensure compliance and provide reasonable assurance that due diligence had been applied in designing and constructing floodproofing measures, the following information must be provided and submitted to FEMA through the NFIP Bureau and Statistical Agent:

- Completed Flood Insurance **Application**
- Completed Floodproofing **Certificate**
- **Photographs** of shields, gates, barriers, or components designed to provide floodproofing protection to the structure
- Written **certification** that the envelope of the structure is watertight with walls substantially impermeable to the passage of water required under 44 CFR 60.3 (c)(3)
- A comprehensive **Maintenance Plan** for the entire structure to include but not limited to:
  - Exterior envelope of structure
  - All penetrations to the exterior of the structure
  - All shields, gates, barriers, or components designed to provide floodproofing protection to the structure
  - All seals or gaskets for shields, gates, barriers, or components
  - Location of all shields, gates, barriers, and components as well as all associated hardware, and any materials or specialized tools necessary to seal the structure.
• Floodproofing to any elevation less than **1 foot above the BFE** will have a serious negative impact on the flood insurance rating for the building.

• A substantially impermeable wall “shall not permit the accumulation of more than **4 inches of water depth during a 24-hour period** if there were no devices provided for its removal. However, sump pumps shall be required to control this seepage.”
  
  – Flood resistant materials must be used in all areas where such seepage is likely to occur (Technical Bulletin 2).

• Floodproofing Certificate
SECTION II – FLOODPROOFING INFORMATION (By a Registered Professional Engineer or Architect)

Elevations are based on: ☐ Construction Drawings ☐ Building Under Construction ☐ Finished Construction

Floodproofing Design Elevation Information:
Building is floodproofed to an elevation of __________ feet (In Puerto Rico only: __________ meters). ☐ NGVD 1929 ☐ NAVD 1988 ☐ Other/Source: ____________________________

(Elevation datum used must be the same as that used for the Base Flood Elevation.)

Height of floodproofing on the building above the lowest adjacent grade is __________ feet (In Puerto Rico only: __________ meters).

For Unnumbered A Zones Only:
Highest adjacent (finished) grade next to the building (HAG) __________ feet (In Puerto Rico only: __________ meters)

☐ NGVD 1929 ☐ NAVD 1988 ☐ Other/Source: ____________________________

(NOTE: For insurance rating purposes, the building’s floodproofed design elevation must be at least 1 foot above the Base Flood Elevation to receive rating credit. If the building is floodproofed only to the Base Flood Elevation, then the building’s insurance rating will result in a higher premium. See the Instructions section for information on documentation that must accompany this certificate if being submitted for flood insurance rating purposes.)

Non-Residential Floodproofed Construction Certification:

I certify the structure, based upon development and/or review of the design, specifications, as-built drawings for construction and physical inspection, has been designed and constructed in accordance with the accepted standards of practice (ASCE 24-14 or its equivalent) and any alterations also meet those standards and the following provisions.

The structure, together with attendant utilities and sanitary facilities is watertight to the floodproofed design elevation indicated above, is substantially impermeable to the passage of water, and shall perform in accordance with the 44 Code of Federal Regulations (44 CFR 60.3(c)(3)).

All structural components are capable of resisting hydrostatic and hydrodynamic flood forces, including the effects of buoyancy, and anticipated debris impact forces.

SECTION II – FLOODPROOFING INFORMATION (By a Registered Prof)

Elevations are based on: □ Construction Drawings □ Building Under Construction □ Finished Construction

All elevations must be based on finished construction.
NOTE: For insurance rating purposes, the building’s floodproofed design elevation must be at least 1 foot above the Base Flood Elevation to receive rating credit. If the building is floodproofed only to the Base Flood Elevation, then the building’s insurance rating will result in a higher premium. See the Instructions section for information on documentation that must accompany this certificate if being submitted for flood insurance rating purposes.
Floodproofing Certificate Instructions

• Photographs of shields, gates, barriers, or components designed to provide floodproofing protection to the structure

• Written certification that the envelope of the structure is watertight with walls substantially impermeable to the passage of water required under 44 Code of Federal Regulations (44 CFR 60.3 (c)(3))

• A comprehensive Maintenance Plan (includes minimum requirements)
I certify that, based upon development and/or review of the structural design, specifications, and plans for construction, the design and methods of construction are in accordance with accepted standards of practice for meeting the following provisions:

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I certify the structure, based upon development and/or review of the design, specifications, as-built drawings for construction and physical inspection, has been designed and constructed in accordance with the accepted standards of practice (ASCE 24-14 or its equivalent) and any alterations also meet those standards and the following provisions.

I certify the structure, based upon development and/or review of the design, specifications, as-built drawings for construction and physical inspection, has been designed and constructed in accordance with the accepted standards of practice (ASCE 24-14 or its equivalent) and any alterations also meet those standards and the following provisions.
• Inspection and Maintenance Plan
  – The community should also be assured that the inspection and maintenance activities required by the plan will continue regardless of changes in the ownership of the floodproofed building. **This assurance should be accomplished by appropriate deed restrictions.** Any lease agreement should also contain clear language stating the leaseholder’s responsibilities for the floodproofed building.
FEMA P-936 Floodproofing Non-Residential Buildings (July 2013)

• Design Considerations in Floodproofing
  – Regulatory Requirements, Building Codes, Design Standards, and Guidance Documents
  – Design Loads and Site Characteristics
  – Other Flood Characteristics
  – Site Factors
  – Functional, Operational, and Economic Factors
  – Building Vulnerability Assessments

• Dry Floodproofing Measures
  – Design Considerations for Dry Floodproofing Project
  – Continuous Impermeable Walls
  – Flood Resistance of Interior Core Areas
  – Shields for Openings
  – Flood Shields for Openings in Exterior Walls
  – Backflow Valves
  – Internal Drainage
  – Flood Emergency Operations Plan and Inspection and Maintenance Plan
  – Dry Floodproofing in New Construction
  – Case Study: University of Texas Perimeter Wall and Dry Floodproofing Project

• Other Flood Protection Measures
Oak Ridge Southeast Region Research Institute (SERRI) Project: Floodproof Commercial Construction and Fortified Residential Construction for Neighborhood-Scale, Mixed-use Buildings

- Sealed Block - sealed block was a concrete masonry unit (CMU) wall structure with a layered polymer membrane exterior coating
- Cavity Wall - CMU wall structure with a fluid-applied rubberized asphaltic emulsion coating between the exterior of the CMU face and the brick exterior finish.
- Unsealed Block - unsealed block was a CMU wall structure with a non-adhesive weather barrier wrapped around the block under fiber cement panels.
- ICF - was constructed using Insulated Concrete Form with a stucco exterior finish
- Metal Stud - metal stud structure with a non-adhesive weather barrier wrapped around the sheathing beneath the brick façade
- Metal SIPs - constructed using metal Structural Insulated Panels set in a steel channel, which had been bolted to the concrete slab.
- Other Configurations
Other

- Terms
  - As an ASFPM Committee we’ve debated the name Non-structural
  - Flood proof
    - Manage expectations/clearly establish limitations (residual risk)
- Life of the building
  - Clearly designate areas
- Local Zoning Requirements
  - Egress
  - Evacuation Zone
- Feasibility
  - 3’ rule of thumb
Can I Dry Floodproof my Building?

- Non-residential – *floodproofing requirements only applies to new construction/substantial improvement, yes or no?*
  - Not if you want credit for flood insurance purposes
Can I Dry Floodproof my Building?

- Residential – *Yes or No*?
  - Is not new construction nor substantial improvement
  - Residential buildings may be floodproofed only if they have basements, are located in zones A1–A30, AE, AR, AR Dual, AO, AH, and A with BFE, and only if they are located in communities specifically approved and authorized by FEMA. Granting of community-wide exceptions for floodproofed residential basements meeting the requirements of 44 CFR 60.6(c) under the National Flood Insurance Program
    - About 50 communities, listed in the Flood Insurance Manual
Can I build a floodwall to meet SI/SD? Does a free-standing floodwall trigger a SI?

• Only if a floodwall qualifies for a map revision that removes areas from the SFHA would buildings no longer be subject to the SI/SD requirements.
  – A free-standing floodwall is not an improvement to the building.
  – In contrast, a secondary wall that is adjacent to and reinforces the existing wall intended to dry floodproof is part of the structure.
Lessons Learned

- Overtop/fail when DFE is exceeded
- Flood loads and points of entry, including slabs
- Flood abatement/sump pump
- Turn the lights back on versus leave the lights on
- Enclosures tend to perform better than entire structure
Summary

- Required versus Recommended
  - 44 CFR – Required in all NFIP Participating Communities
  - IBC – Required everywhere the IBC is adopted for new and SI/SD
  - ASCE 24 – Required everywhere the IBC is adopted for new and SI/SD
    - ASCE 24 is an HMA requirement
  - ANSI/FM Approvals 2510 – Recommended
  - Flood Insurance Manual & TB 3-93 – Required if seeking floodproofing credit
    - TB 3-93 is an HMA requirement regardless of SI/SD
  - FEMA P-936 – Recommended
Conclusion

• Presentation focused on “Can I Dry Floodproof my Building?” however the more important question to take away is “Should I Dry Floodproof my Building?”
  – Evacuation Zone
  – Site Limitations – floodway, velocity, warning time, etc.
  – Operations and Maintenance
  – Not impossible, but can be unmanageable
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