



ASCE 24-24 Updates



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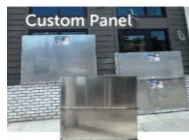
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DEPLOYABLE FLOOD BARRIERS



PASSIVE FLOODPROOFING SYSTEMS



POINT-OF-USE SYSTEMS



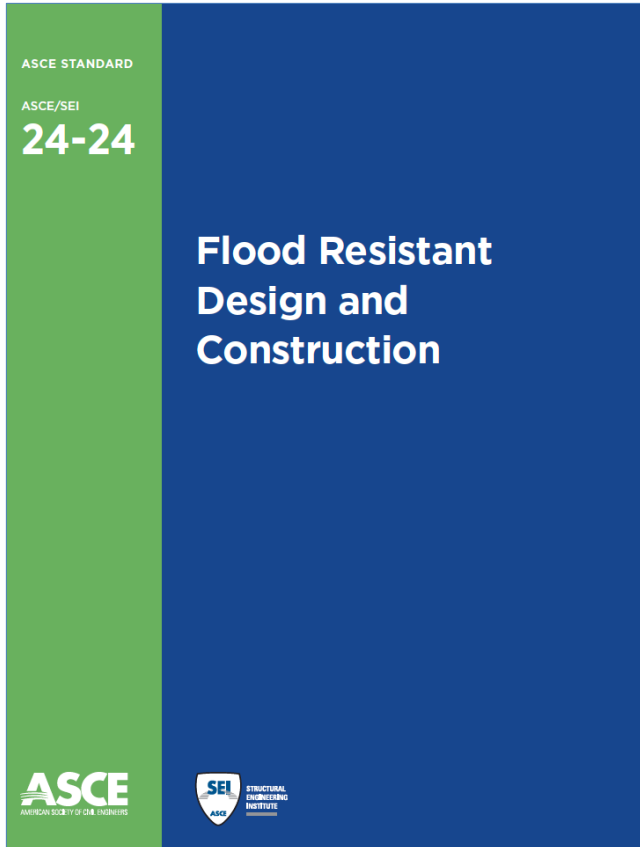
PERIMETER FLOOD BARRIERS



FLOOD VENTS



ASCE 24-24 Update



Abstract prepared by the ASCE 24 Flood Resistant Design and Construction Standards Committee of the Structural Engineering Institute of ASCE.

*Flood Resistant Design and Construction, ASCE/SEI 24-24, provides minimum requirements for flood resistant design and construction of structures that are subject to building code requirements or floodplain management regulations in flood hazard areas. **This standard applies to new construction, including subsequent work to such structures, and work classified as substantial improvement of existing structures that are not historic structures.***

ASCE 24-24 contains significant changes from the previous version and aligns with the ASCE 7-22 Supplement 2: the Flood Hazard Area expanded to include land in the 500-year floodplain; the Design Flood Elevation corresponds to the greater of the elevation set by the community or the elevation pertaining to the MRI flood event for the Flood Design Class plus Sea Level Rise; and flood loads for use in design calculated in accordance with ASCE 7-22 Supplement 2.

This revised standard is intended to meet or exceed FEMA's National Flood Insurance Program requirements and protect public safety and property.

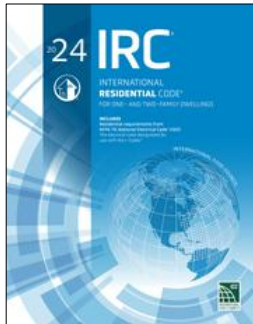
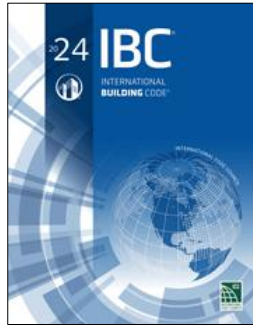
Among others, revisions cover:

- Elevation requirements;
- Clarifications to Flood Design Class for agricultural structures, hospitals, health care facilities, and ambulatory care facilities;
- Definitions for residential portions of mixed-use buildings and flood barriers and shields;
- Use of flood mitigation pumps and valves for passage of water and removal of accumulated water;
- Inspection and maintenance needs and flood emergency operation plans; and
- Placement of attendant utilities and equipment; and automatic pressure control valves for gas and fuel supply lines.

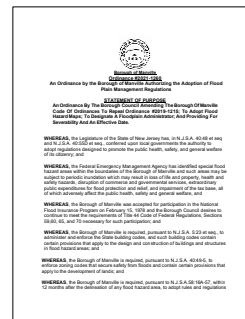
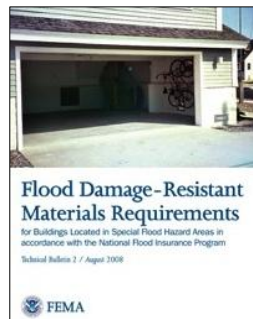
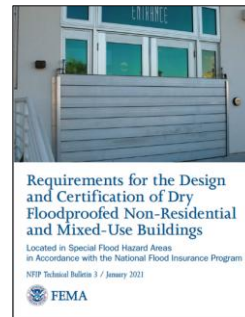
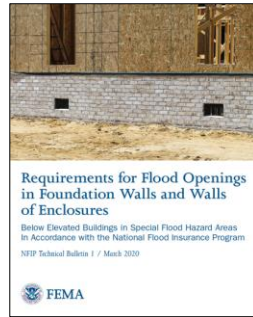
ASCE 24-24 updates and replaces the previous version, ASCE/SEI 24-14. It provides essential guidance on design and construction to structural engineers, design professionals, code officials, floodplain managers, and building owners. The standard is adopted by reference in model building codes.

Where To Get Started in Floodplain Design and Construction

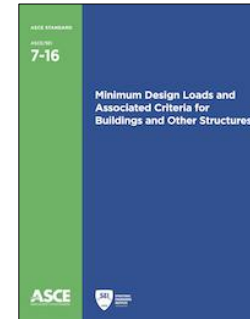
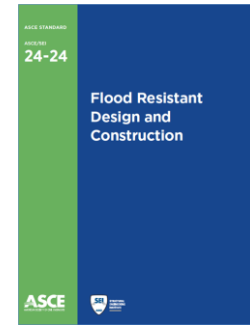
Codes: National + State



Regulations: FEMA, NFIP, Floodplain Ordinances

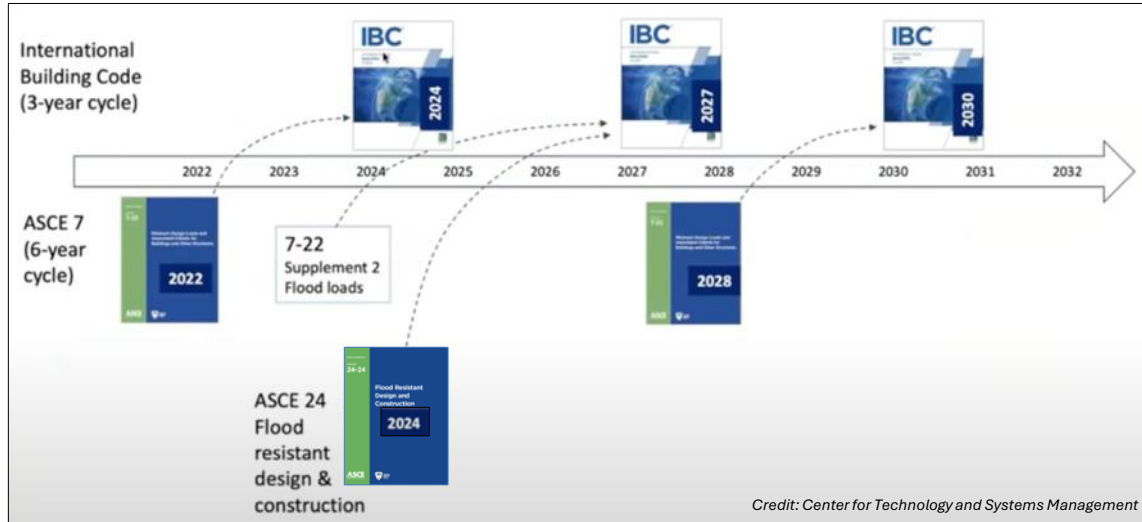


Standards: ASCE



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From ASCE Standard to ICC Code Adoption



1. Can be adopted early by:

- i. Local Floodplain Ordinances
- ii. State Building Codes
- iii. Project-specific Specifications

2. Will soon be required for federally funded projects.

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Expanded Flood Hazard Area and Flood Loads

1.3 IDENTIFICATION OF FLOOD HAZARD AREAS

For **Flood Design Classes 2, 3, and 4 structures**, the flood hazard area shall be the larger of (1) the lands within the mapped **500-year floodplain (0.2% or greater chance of flooding in any year, including the 1% floodplain) on a FIRM**, and (2) those lands designated as a flood hazard area on the community's flood hazard map, or otherwise legally designated (this includes the 1% floodplain).

For Flood Design Class 1 structures, the flood hazard area shall be the larger of (1) the lands within the mapped 100-year floodplain (1% or greater chance of flooding in any year) on a FIRM, and (2) those lands designated as a flood hazard area on the community's flood hazard map, or otherwise legally designated. The Flood Design Class of a structure shall be as determined by Section 1.4.3.

1.6 LOADS IN FLOOD HAZARD AREAS

1.6.1 General Design of structures within flood hazard areas shall be governed by the loading provisions of ASCE 7.



ASCE 24-24 made changes to align with ASCE 7-22, Supplement 2 by extending the flood hazard area to include land in the 500-year floodplain.



Flood loads for use in design are now calculated in accordance with ASCE 7-22 Supplement 2.

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Flood Design Class of Buildings and Structures

Flood Design Class 1: Buildings and structures that normally are unoccupied and pose minimal risk or disruption to the public or community should they be damaged or fail due to flooding. Includes: Temporary structures that are in place for less than 180 days; Accessory storage structures and structures used for parking of vehicles; Certain agricultural structures.

Flood Design Class 2: Buildings that pose a moderate risk or disruption to the public or community should they be damaged or fail due to flooding. Includes: most buildings and structures *that are not specifically assigned another Flood Design Class*, including most residential, commercial, and industrial buildings.

Flood Design Class 3: Buildings and structures that pose a high risk to the public or significant disruption to the community should they be damaged, be unable to perform their intended functions after flooding, or fail due to flooding. Includes: Buildings and structures in which a large number of persons may assemble in one place, such as theaters, lecture halls, concert halls, and religious institutions with large areas used for worship; Museums; Community centers and other recreational facilities; Athletic facilities with seating for spectators; Elementary schools, secondary schools, and buildings with college or adult education classrooms; Jails, correctional facilities, and detention facilities; Healthcare facilities other than hospitals not having emergency surgery or emergency treatment capabilities; Ambulatory care facilities; Hospitals not having surgery or emergency treatment facilities; Care facilities where residents have limited mobility or ability, including nursing homes but not including care facilities for five or fewer persons; Preschool and childcare facilities not located in one- and two-family dwellings; Buildings and structures associated with power generating stations, water and sewage treatment plants, telecommunication facilities, and other utilities which, if their operations were interrupted by a flood, would cause significant disruption in day-to-day life or significant economic losses in a community; Buildings and other structures not included in Flood Design Class 4 containing toxic or explosive substances where the quantity of the material exceeds a threshold quantity established by the community and is sufficient to pose a threat to the public if released.

Flood Design Class 4: Buildings and structures that contain essential facilities and services necessary for emergency response and recovery, or that pose a substantial risk to the community at large in the event of failure, disruption of function, or damage by flooding. Includes: Hospitals having surgery or emergency treatment facilities; Health care facilities having emergency surgery or emergency treatment capabilities; Fire, rescue, ambulance, and police stations and emergency vehicle garages; Designated emergency shelters; Designated emergency preparedness, communication, and operation centers and other facilities required for emergency response; Power generating stations and other public utility facilities required in emergencies; Critical aviation facilities such as control towers, air traffic control centers, and hangars for aircraft used in emergency response; Ancillary structures such as communication towers, electrical substations, fuel or water storage tanks, or other structures necessary to allow continued functioning of a Flood Design Class 4 facility during and after an emergency; Buildings and other structures containing sufficient quantities of highly toxic substances where the quantity of the material exceeds a threshold quantity established by the community and is sufficient to pose a threat to the public if released.

ASCE 24-24 Update

Required Minimum Elevation and DFE Determination

Flood Design Class	Required Minimum Elevation of the Lowest Floor	Required Minimum Elevation of the Bottom of the Lowest Horizontal Structural Member of the Lowest Floor	Required Minimum Dry Floodproofing Elevation	
	Flood Hazard Areas Other than CHHAs and CAZs	CHHAs and CAZs	Flood Hazard Areas Other than CHHAs and CAZs	CHHAs and CAZs
1	DFE	DFE	BFE + 1 ft (0.3 m) or DFE, whichever is higher	Not Allowed
2	BFE + 1 ft (0.3 m) or DFE, whichever is higher	BFE + 1 ft (0.3 m) or DFE, whichever is higher	BFE + 1 ft (0.3 m) or DFE, whichever is higher	
3	BFE + 2 ft (0.6 m) or DFE, whichever is higher	BFE + 2 ft (0.6 m) or DFE, whichever is higher	BFE + 2 ft (0.6 m) or DFE, whichever is higher	
4	BFE + 2 ft (0.6 m) or DFE, whichever is higher	BFE + 2 ft (0.6 m) or DFE, whichever is higher	BFE + 2 ft (0.6 m) or DFE, whichever is higher	

Enclosed areas and detached structures that are used solely for parking of vehicles, building access, or storage are not the lowest floor and non-residential structures and non-residential portions of mixed-use structures shall be allowed to have the lowest floor (including basements) below the minimum elevations, provided the enclosed areas meet the requirements.

For the purpose of Table 1-2, the DFE shall be calculated using the Equation (1-1):

$$DFE = FE_{com} \text{ or } (FE_{MRI} + \Delta_{SLC}), \text{ whichever is higher} \quad (1-1)$$

where

FE_{com} = Flood elevation established by the community, and
 FE_{MRI} = Elevation based on the required minimum MRI flood event for the Flood Design Class of the building or structure, as determined in Section 1.5.2.1 for non-coastal flood sources and Section 1.5.2.2 for coastal flood sources.

Where a building or structure is located at a site subject to flooding by noncoastal sources and coastal sources of flooding, FE_{MRI} shall be calculated for both sources in accordance with Section 1.5.2.1 and 1.5.2.2, and the higher elevation shall be used.

Δ_{SLC} = Relative Sea Level Change; see Section 1.5.2.3. Δ_{SLC} shall not be taken as less than 0.

The **Design Flood Elevation** now corresponds to the **greater of the elevation set by the community or the elevation pertaining to a Mean Recurrence Interval** corresponding to the Flood Design Class plus Sea Level Rise. This change aligns ASCE 24 with ASCE 7-22 Supplement 2.

The Mean Recurrence Interval (MRI) for:

- Flood Design Class 1 is 100-year (1% annual change flood event)
- Flood Design Class 2 is 500-year (0.2% annual change flood event)
- Flood Design Class 3 is 750-year (0.13% annual change flood event)
- Flood Design Class 4 is 1000-year (0.1% annual change flood event)

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Flood Barrier Definitions

Shield: Removable or permanently installed substantially impermeable protective flood barrier (i.e., door, panel, or other cover) used at non-flood openings along with all necessary accessories, where such non-flood openings are below the level of protection for which the dry floodproofing measures have been designed. Shields shall meet the requirements of opening barrier applications and include permanent fixed passive, permanent automatic passive, permanent active, or contingent active.

Opening Barrier Applications: Applications in which a flood barrier is used to protect against water entering through a non-flood opening in a structure between two linear points (i.e., doorway, window, receiving bay, etc.). **The barrier is supported by the permanent structure on both sides or along the full perimeter of the barrier/non-flood opening.** Typical products used in opening barrier applications include flood doors, flood panels, and flood planks. Other products may include but are not limited to flexible membrane barriers, sluice gates, and flood glazing.

Contingent Flood Barrier: Barrier that is not permanently installed and affixed to a structure, and which requires some level of transportation and manual deployment. **Some elements of the barrier/product may be permanently pre-installed (i.e., frame), but the main components are temporary and require manual deployment.** Contingent flood barriers may only be classified as active protection.

Permanent Flood Barrier: **Barrier that is pre-installed and permanently affixed to a structure.** Permanent flood barriers may or may not require manual deployment. Examples of permanent flood barriers requiring manual deployment include flood doors, hinged gates, sluice gates, and others.

Active Flood Barrier: **Barrier that requires human intervention for manual deployment.** Active flood barriers may either be permanent or contingent.

Passive Flood Barrier: **Permanent barrier that, after its initial installation, requires no deployment or human intervention for deployment.** Examples of passive protection are flood glazing, and automatic barriers. Passive flood barriers may only be classified as permanent.

Automatic Flood Barrier: **Permanent, passive barrier that automatically deploys without human intervention when flood conditions are detected.** Types of automatic flood barriers may include, but are not limited to, buoyancy driven (horizontal or vertical) and pneumatic or hydraulic activated by water sensors.

Fixed Flood Barrier: **Passive barrier that is a permanently installed nonmechanized component of the wall and requires no deployment.** Types of fixed flood barriers may include but are not limited to glazing and wall components that are substantially impermeable and capable of resisting the flood loads specified by Section 1.6.

Floodproofing Systems Overview



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Allowable Shield Types per Flood Design Class

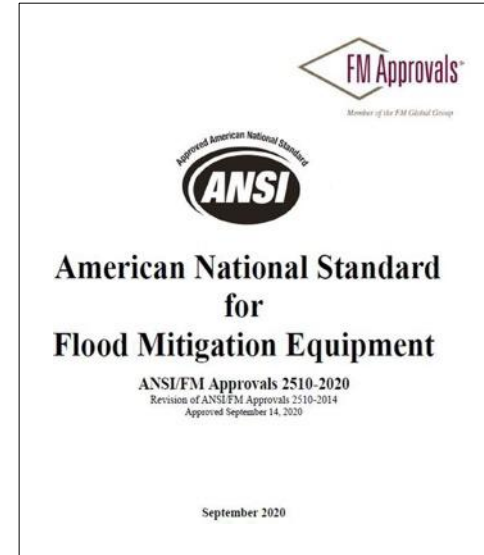
Flood Design Class	New Construction	Substantial Improvement
1	Permanent Fixed Passive Permanent Automatic Passive Permanent Active Contingent Active (stored on or off site)	Permanent Fixed Passive Permanent Automatic Passive Permanent Active Contingent Active (stored on or off site)
2	Permanent Fixed Passive Permanent Automatic Passive Permanent Active Contingent Active (stored on)	Permanent Fixed Passive Permanent Automatic Passive Permanent Active Contingent Active (stored on or off site)
3	Permanent Fixed Passive Permanent Automatic Passive Permanent Active Contingent Active (stored on site)	Permanent Fixed Passive Permanent Automatic Passive Permanent Active Contingent Active (stored on site)
4*	Permanent Fixed Passive Permanent Automatic Passive Permanent Active	Permanent Fixed Passive Permanent Automatic Passive Permanent Active

*Only permanent flood barriers that are pre-installed and permanently affixed to a structure are permitted for Flood Design Class 4, so they are always required to be on site.

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Shields must meet ANSI/FM 2510

- The shields and all necessary accessories for the shields shall be tested to and certified to meet the applicable requirements of the American National Standard for Flood Mitigation Equipment, ANSI/FM 2510.
- In an existing building where substantial improvement is triggered, when an available ANSI/FM 2510 tested and certified shield does not meet the required maximum width or water depth specifications for a particular installation, a licensed design professional shall evaluate on a case-by-case basis to determine the acceptability of increasing the size of an available ANSI/FM 2510 tested and certified shield. The design professional must have a minimum of 5 years' experience in flood resistant design, and such specifications are restricted to substantial improvements rather than new construction.
- Contingent active shields shall be stored on site for all Flood Design Class 3 and new Flood Design Class 2 construction.
- Whereas ANSI/FM 2510 tests for hydrostatic load, system leakage, dynamic impact load, and other parameters, a registered design professional shall provide calculations showing detailed analysis of all specified structural loads acting against the wall or shield and demonstrate anchorage to the building that meets the loading provisions of Section 1.6.



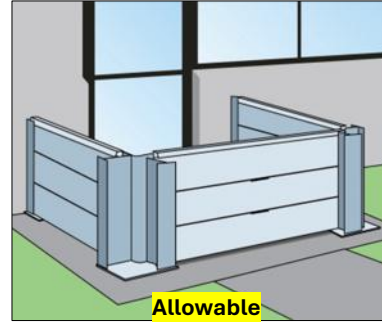
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Shield Limitations

- The shields for allowable non-flood openings are permitted to be connected and sealed to the building by way of a permanent or temporary wall (if/when necessary, based on the design) **that extends no further than required** for the door swing, ventilation, egress, or other building code requirements.
- The general performance expectation of NFIP is that walls and floors will be substantially impermeable. Therefore, **shields shall not be used to protect walls** and elements of building exteriors that function as walls, [i.e., elements not intended for access and egress or natural ventilation, **such as glass curtain walls and storefront (fixed) windows**].



Example of unallowable shield configurations (non-opening barrier due to nonlinearity) protecting an unallowable non-flood opening (permeable curtain wall) for new construction and substantial improvements.



Example of an allowable shield serving as a temporary wall extending from the building.



Example of an allowable permanent wall extending from the building.



Example of a shield configuration protecting an unallowable non-flood opening (permeable curtain wall) for new construction and substantial improvements.

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Inspection Requirements

- Required Plans: Inspection, Maintenance, and Flood Emergency Operations
- At a minimum, the plan shall include a full-scale deployment inspection annually (or as required by the Authority Having Jurisdiction) of all dry floodproofing system components conducted in the presence of an inspection agency that is qualified to perform flood zone compliance inspections or registered professional engineer or architect licensed where the building is located.

Limits on Human Intervention

- Dry floodproofing measures that require human intervention to activate or implement prior to or during a flood shall be permitted only when the time required to implement the measures is less than:
 - ☐ 12 hours for Flood Design Class 1 & 2
 - ☐ 8 hours for Flood Design Class 3
 - ☐ 4 hours for Flood Design Class 4
- For structures with permanent automatic passive measures the plan should include an audio or visual device to alert the building owner or designated representative as well as occupants that the measures have been implemented and additional steps in the operations plan may be triggered.

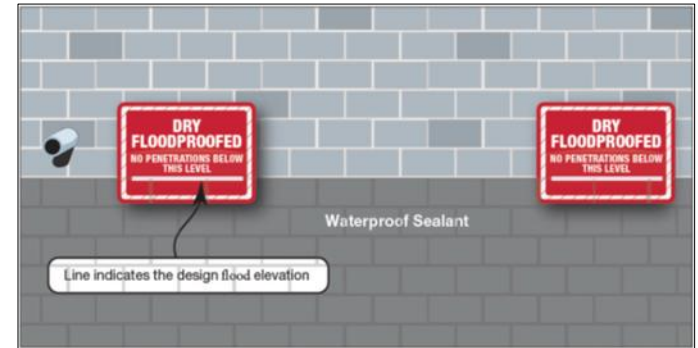
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Flood Warning Systems

- Designers can utilize a community warning system and/or **specify a flood warning system that is specific to the facility** with the ability to provide necessary alerts in accordance with the operations plan.
- The minimum time for a flood warning system to monitor potential flood conditions and issue an alert to implement measures (alerting those in charge of the building and responsible flood mitigation designee of a pending flood situation) shall be:
 - ☐ 12 hours for Flood Design Class 1 and 2
 - ☐ 24 hours for Flood Design Class 3
 - ☐ 36 hours for Flood Design Class 4

Wall Identification

- All substantially impermeable walls and any other portion of the building required to have protected non-flood openings or penetrations shall be permanently identified with signs or stenciling.



Example marking on a substantially impermeable wall.

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Flood Openings

- The NFIP and building codes require the design of **engineered flood openings to be certified by a registered design professional**. Acceptable documentation of product certification **includes ICC-ES Evaluation Reports** or product evaluation reports from other product certification organizations approved by the Authority Having Jurisdiction and individual certifications for specific buildings.
- Certification requires more than simply applying the equation in this section; it requires consideration of a number of factors that represent expected base flood conditions, best accomplished by testing over a range of those conditions.
- **Flood openings with moving parts** that depend on the presence of water **shall meet the requirements for engineered flood openings**.
- Where experience has shown that a particular device or type of device has been blocked or clogged by flood debris or sediment, use of such devices should be avoided.
- For enclosed areas with one exterior wall, flood openings in that one exterior wall shall be permitted. For buildings on sloped sites where the exterior grade is below the required elevation on only one exterior wall, the flood openings required for the enclosed area shall be located on that exterior wall.
- Where building access is provided through a wet floodproofed enclosed area, an additional door above the DFE satisfying the same performance and building code requirements as the exterior door to the enclosed area shall be provided above and within any such enclosure.

ASCE 24-24 Update

Miscellaneous

- New in this edition is a requirement in dry floodproofed areas that cover multiple stories to allow for the automatic passage of water between floors to limit the accumulation of flood loads on a floor system should the dry floodproofed area become inundated with floodwater.
- New in this edition of this standard is the requirement for Flood Design Classes 3 and 4 structures to have electrical connections for a temporary power source or onsite emergency generators and fuel supplies above the elevation required.
- New to this edition is a clarification that “attendant utilities and equipment serving residential buildings and residential portions of mixed-use buildings” in new construction “shall not be permitted in areas of structure that are dry floodproofed below the minimum elevation”. Only building utility systems and equipment that serve non-residential buildings and non-residential portions of mixed-use buildings are allowed in dry floodproofed areas. This requirement does not apply to utility company equipment that services the entire building (e.g., transformers placed below the minimum elevation per utility company requirements).
- Flood mitigation pumps shall be provided to remove water accumulated due to any passage of vapor, seepage, wind-driven rain or rainwater, or limited overtopping of water during the flooding event. Flood mitigation pumps shall discharge above the required elevation or as required by the community with appropriate measures to mitigate the passage of water into the dry floodproofed area. Emergency power should be provided to run the pumps.



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AIA COURSE TITLE: FLOODPLAIN DESIGN, CONSTRUCTION,
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Projects?



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