FEMA Fact Sheet

# Flood-Resistant Provisions of the 2021 International Codes®

This document contains excerpts of the flood-resistant provisions from the 2021 editions of the International Codes® (I-Codes®), prepared by FEMA with permission from the International Code Council (ICC).

Read I-Codes online: https://codes.iccsafe.org/codes/i-codes

## Introduction

This document contains excerpts of the flood-resistant provisions from the 2021 editions of the following I-Codes:

- International Building Code® (IBC)
- International Residential Code® (IRC)
- International Existing Building Code® (IEBC)
- International Mechanical Code® (IMC)
- International Plumbing Code® (IPC)
- International Fuel Gas Code® (IFGC)
- International Fire Code® (IFC)
- International Swimming Pool and Spa Code® (ISPSC)
- International Private Sewage Disposal Code® (IPSDC)
- International Code Council Performance Code® (ICCPC)

FEMA

# 2021 International Building Code® (IBC)
# Compilation of flood-resistant provisions prepared by FEMA



## CHAPTER 1 SCOPE AND ADMINISTRATION

**[A] 101.2 Scope.** The provisions of this code shall apply to the construction, *alteration*, relocation, enlargement, replacement, *repair*, equipment, use and occupancy, location, maintenance, removal and demolition of every building or structure or any appurtenances connected or attached to such buildings or structures.

> **Exception:** Detached one- and two-family *dwellings* and *townhouses* not more than three *stories above grade plane* in height with a separate *means of egress*, and their accessory structures not more than three stories above grade plane in height, shall comply with this code or the *International Residential Code*.

**[A] 101.2.1 Appendices.** Provisions in the appendices shall not apply unless specifically adopted.

**[A] 104.2.1 [Duties and powers of the building official] Determination of substantially improved or substantially damaged existing buildings and structures in flood hazard areas.** For applications for reconstruction, rehabilitation, *repair, alteration, addition* or other improvement of existing buildings or structures located in *flood hazard areas*, the *building official* shall determine if the proposed work constitutes substantial improvement or *repair* of *substantial damage*. Where the *building official* determines that the proposed work constitutes *substantial improvement* or *repair* of *substantial damage*, and where required by this code, the *building official* shall require the building to meet the requirements of Section 1612 or Section R322 of the *International Residential Code*, as applicable.

**[A] 104.7 Department records.** The *building official* shall keep official records of applications received, *permits* and certificates issued, fees collected, reports of inspections, and notices and orders issued. Such records shall be retained in the official records for the period required for retention of public records.

**[A] 104.10.1 [Modifications] Flood hazard areas.** The *building official* shall not grant modifications to any provision required in *flood hazard areas* as established by Section 1612.3 unless a determination has been made that:

1. A showing of good and sufficient cause that the unique characteristics of the size, configuration or topography of the site render the elevation standards of Section 1612 inappropriate.
2. A determination that failure to grant the variance would result in exceptional hardship by rendering the lot undevelopable.

3. A determination that the granting of a variance will not result in increased flood heights, additional threats to public safety, extraordinary public expense, cause fraud on or victimization of the public, or conflict with existing laws or ordinances.
4. A determination that the variance is the minimum necessary to afford relief, considering the flood hazard.
5. Submission to the applicant of written notice specifying the difference between the design flood elevation and the elevation to which the building is to be built, stating that the cost of flood insurance will be commensurate with the increased risk resulting from the reduced floor elevation, and stating that construction below the design flood elevation increases risks to life and property.

**[A] 107.2.6 [Construction documents] Site plan.** The *construction documents* submitted with the application for *permit* shall be accompanied by a site plan showing to scale the size and location of new construction and *existing structures* on the *site*, distances from *lot lines*, the established street grades and the proposed finished grades and, as applicable, *flood hazard areas*, *floodways*, and *design flood elevations*; and it shall be drawn in accordance with an accurate boundary line survey. In the case of demolition, the site plan shall show construction to be demolished and the location and size of *existing structures* and construction that are to remain on the *site* or plot. The *building official* is authorized to waive or modify the requirement for a site plan where the application for *permit* is for *alteration* or *repair* or where otherwise warranted.

**[A] 107.2.6.1 Design flood elevations.** Where *design flood elevations* are not specified, they shall be established in accordance with Section 1612.3.1.

**[A] 110.3.3 [Required inspections] Lowest floor elevation.** In *flood hazard areas*, upon placement of the *lowest floor*, including the *basement*, and prior to further vertical construction, the elevation certification required in Section 1612.4 or *International Residential Code*, as applicable, shall be submitted to the *building official*.

**[A] 110.3.12.1 [Final inspection] Flood hazard documentation.** If located in a *flood hazard area*, documentation of the elevation of the *lowest floor* as required in Section 1612.4 shall be submitted to the *building official* prior to the final inspection.

## SECTION 202 DEFINITIONS

**[A] ADDITION.** An extension or increase in floor area, number of *stories* or height of a building or structure.

**[A] ALTERATION.** Any construction or renovation to an *existing structure* other than *repair* or *addition*.

**[BS] BASE FLOOD.** The *flood* having a 1-percent chance of being equaled or exceeded in any given year.

**[BS] BASE FLOOD ELEVATION.** The elevation of the *base flood*, including wave height, relative to the National Geodetic Vertical Datum (NGVD), North American Vertical Datum (NAVD) or other datum specified on the *Flood Insurance Rate Map* (FIRM).

**BASEMENT.** A *story* that is not a *story above grade plane* (see "*Story above grade plane*"). This definition of "Basement" does not apply to the provisions of Section 1612 for *flood loads*.

**[BS] BASEMENT (for flood loads).** The portion of a building having its floor subgrade (below ground level
This definition of "Basement" is limited in application to the provisions of Section 1612.

**[A] BUILDING.** Any structure utilized or intended for supporting or sheltering any occupancy.

**[BS] COASTAL A ZONE.** Area within a *special flood hazard area*, landward of a V zone or landward of an o
without mapped *coastal high-hazard areas*. In a *coastal A zone*, the principal source of *flooding* must be
astronomical tides, storm surges, seiches or tsunamis, not riverine *flooding*. During the *base flood* conditi
potential for breaking wave height shall be greater than or equal to 1 ½ feet (457 mm). The inland limit o
*coastal A zone* is (a) the *Limit of Moderate Wave Action* if delineated on a FIRM, or (b) designated by the authority having jurisdiction.

**[BS] COASTAL HIGH-HAZARD AREA.** Area within the *special flood hazard area* extending from offshore to the inland limit of a primary dune along an open coast and any other area that is subject to high-velocity wave action from storms or seismic sources, and shown on a Flood Insurance Rate Map (FIRM) or other flood hazard map as velocity Zone V, VO, VE or V1-30.

**[BS] DANGEROUS.** Any building, structure or portion thereof that meets any of the conditions described below shall be deemed *dangerous:*

1. The building or structure has collapsed, has partially collapsed, has moved off its foundation or lacks the necessary support of the ground.
2. There exists a significant risk of collapse, detachment or dislodgment of any portion, member, appurtenance or ornamentation of the building or structure under permanent, routine, or frequent *loads*; under actual loads already in effect; or under snow, wind, rain, *flood*, earthquake, or other environmental loads when such *loads* are imminent.

**[BS] DESIGN FLOOD.** The *flood* associated with the greater of the following two areas:

1. Area with a flood plain subject to a 1-percent or greater chance of *flooding* in any year.
2. Area designated as a *flood hazard area* on a community's flood hazard map, or otherwise legally designated.

**[BS] DESIGN FLOOD ELEVATION.** The elevation of the "*design flood*," including wave height, relative to the datum specified on the community's legally designated flood hazard map. In areas designated as Zone AO, the *design flood elevation* shall be the elevation of the highest existing grade of the building's perimeter plus the depth number (in feet) specified on the flood hazard map. In areas designated as Zone AO where a depth number is not specified on the map, the depth number shall be taken as being equal to 2 feet (610 mm).

**[BS] DRY FLOODPROOFING.** A combination of design modifications that results in a building or structure, including the attendant utilities and equipment and sanitary facilities, being water tight with walls substantially impermeable to the passage of water and with structural components having the capacity to resist *loads* as identified in ASCE 7.

**[A] EXISTING BUILDING.** A building erected prior to the date of adoption of the appropriate code, or one for which a legal building *permit* has been issued.

**[BS] EXISTING STRUCTURE.** A structure erected prior to the date of adoption of the appropriate code, or one for which a legal building *permit* has been issued.

**[BS] FLOOD DAMAGE-RESISTANT MATERIALS.** Any construction material capable of withstanding direct and prolonged contact with floodwaters without sustaining any damage that requires more than cosmetic *repair*.

**[BS] FLOOD HAZARD AREA.** The greater of the following two areas:

1. The area within a flood plain subject to a 1-percent or greater chance of flooding in any year.
2. The area designated as a flood hazard area on a community's flood hazard map, or otherwise legally designated.

**[BS] FLOOD INSURANCE RATE MAP (FIRM).** An official map of a community on which the Federal Emergency Management Agency (FEMA) has delineated both the *special flood hazard areas* and the risk premium zones applicable to the community.

**[BS] FLOOD INSURANCE STUDY.** The official report provided by the Federal Emergency Management Agency containing the *Flood Insurance Rate Map* (FIRM), the Flood Boundary and *Floodway* Map (FBFM), the water surface elevation of the *base flood* and supporting technical data.

**[BS] FLOOD or FLOODING.** A general and temporary condition of partial or complete inundation of normally dry land from:

1. The overflow of inland or tidal waters.
2. The unusual and rapid accumulation or runoff of surface waters from any source.

**[BS] FLOODWAY.** The channel of the river, creek or other watercourse and the adjacent land areas that must be reserved in order to discharge the *base flood* without cumulatively increasing the water surface elevation more than a designated height.

**HISTORIC BUILDINGS.** Any building or structure that is one or more of the following:

1. Listed or certified as eligible for listing by the State Historic Preservation Officer or the Keeper of the National Register of Historic Places, in the National Register of Historic Places.
2. Designated as historic under an applicable state or local law.
3. Certified as a contributing resource within a National Register, state designated or locally designated historic district.

**[BS] LIMIT OF MODERATE WAVE ACTION.** Line shown on FIRMs to indicate the inland limit of the 1 ½-foot (457 mm) breaking wave height during the base flood.

**[BS] LOWEST FLOOR.** The *lowest floor* of the lowest enclosed area, including *basement*, but excluding any unfinished or flood-resistant enclosure, usable solely for vehicle parking, building access or limited storage provided that such enclosure is not built so as to render the structure in violation of Section 1612.

**[A] REPAIR.** The reconstruction, replacement or renewal of any part of an existing building for the purpose of its maintenance or to correct damage.

**[BS] RISK CATEGORY.** A categorization of buildings and *other structures* for determination of *flood*, wind, snow, ice and earthquake *loads* based on the risk associated with unacceptable performance.

**[BS] SPECIAL FLOOD HAZARD AREA.** The land area subject to flood hazards and shown on a *Flood Insurance Rate Map* or other flood hazard map as Zone A, AE, A1-30, A99, AR, AO, AH, V, VO, VE or V1-30.

**[BS] 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.

**[BS] SUBSTANTIAL IMPROVEMENT.** Any *repair*, reconstruction, rehabilitation, *alteration*, *addition* or other improvement of a building or structure, the cost of which equals or exceeds 50 percent of the market value of the structure before the improvement or repair is started. If the structure has sustained *substantial damage*, any repairs are considered substantial improvement regardless of the actual *repair* work performed. The term does not, however, include either:

1. Any project for improvement of a building required to correct existing health, sanitary or safety code violations identified by the *building official* and that are the minimum necessary to assure safe living conditions.
2. Any *alteration* of a historic structure provided that the *alteration* will not preclude the structure's continued designation as a historic structure.

## CHAPTER 8 INTERIOR FINISHES

**802.4 Applicability.** For buildings in flood hazard areas as established in Section 1612.3, *interior finishes*, *trim* and *decorative materials* below the elevation required by Section 1612 shall be flood-damage-resistant materials.

## CHAPTER 11 ACCESSIBILITY

**1108.7.5 [General exceptions] Flood hazard areas.** *Type A units* and *Type B units* shall not be required for buildings without elevator service that are located in *flood hazard areas* as established in Section 1612.3, where the minimum required elevation of the *lowest floor* or lowest supporting horizontal structural member, as applicable, results in all of the following:

1. A difference in elevation between the minimum required floor elevation at the primary entrances and vehicular and pedestrian arrival points within 50 feet (15,240 mm) exceeding 30 inches (762 mm).
2. A slope exceeding 10 percent between the minimum required floor elevation at the primary entrances and vehicular and pedestrian arrival points within 50 feet (15,240 mm).

Where such arrival points are not within 50 feet (15,240 mm) of the primary entrances, the closest arrival points shall be used.

## CHAPTER 12 INTERIOR ENVIRONMENT

**1202.4.4 [Under-floor ventilation] Flood hazard areas.** For buildings in *flood hazard areas* established in Section 1612.3, the openings for under-floor ventilation shall be deemed as meeting the flood opening requirements of ASCE 24 provided that the ventilation openings are designed and installed in accordance with ASCE 24.

## CHAPTER 14 EXTERIOR WALLS

**[BS] 1402.6 [Performance Requirements] Flood resistance.** For buildings in *flood hazard areas* as established in Section 1612.3, *exterior walls* extending below the elevation required by Section 1612 shall be constructed with flood damage-resistant materials.

**[BS] 1402.7 [Performance Requirements] Flood resistance for coastal high-hazard areas and coastal A zones.** For buildings in *coastal high-hazard areas* and *coastal A zones* as established in Section 1612.3, electrical, mechanical and plumbing system components shall not be mounted on or penetrate through *exterior walls* that are designed to break away under *flood loads*.

## CHAPTER 16 STRUCTURAL DESIGN REQUIREMENTS

**1602.1 Notations.** *[partial shown]*

$F_a$ = Flood load in accordance with Chapter 5 of ASCE 7.

**1603.1 [Construction Documents] General.** *Construction documents* shall show the size, section and relative locations of structural members with floor levels, column centers and offsets dimensioned. The design loads and other information pertinent to the structural design required by Sections 1603.1.1 through 1603.1.9 shall be indicated on the *construction documents*.

> **Exception:** *Construction documents* for buildings constructed in accordance with the *conventional light-frame construction* provisions of Section 2308 shall indicate the following structural design information:

1. Floor and roof dead and live loads.
2. Ground snow load, $p_g$.
3. Basic design wind speed, *V*, miles per hour (mph) (km/hr) and allowable stress design wind speed, $V_{asd}$, as determined in accordance with Section 1609.3.1 and wind exposure.
4. *Seismic design category* and *site class*.
5. Flood design data, if located in *flood hazard areas* established in Section 1612.3.
6. Design load-bearing values of soils.
7. Rain load data.

**1603.1.7 [Construction Documents] Flood design data.** For buildings located in whole or in part in *flood hazard areas* as established in Section 1612.3, the documentation pertaining to design, if required in Section 1612.4, shall

be included and the following information, referenced to the datum on the community's *Flood Insurance Rate Map* (FIRM), shall be shown, regardless of whether flood loads govern the design of the building:

1. Flood *design* class assigned according to ASCE 24.
2. In *flood hazard areas* other than *coastal high hazard areas* or *coastal A zones*, the elevation of the proposed *lowest floor*, including the basement.
3. In *flood hazard areas* other than *coastal hazard areas* or *coastal A zones*, the elevation to which any nonresidential building will be dry floodproofed.
4. In *coastal high hazard areas* and *coastal A zones*, the proposed elevation of the bottom of the lowest horizontal structural member of the *lowest floor*, including the basement.

**1605.1 [Load Combinations] General.**

Buildings and *other structures* and portions thereof shall be designed to resist the strength load combinations specified in ASCE 7, Section 2.4, or the alternative *allowable stress design* load combinations of Section 1605.2.

**Exceptions:**

1. The modifications to load combinations of ASCE 7 Section 2.3, ASCE 7 Section 2.4, and Section 1605.2 specified in ASCE 7 Chapters 18 and 19 shall apply.
2. Where the allowable stress design load combinations of ASCE 7 Section 2.4 are used, flat roof snow *loads* of 30 pounds per square foot (1.44 kN/m$^2$) and *roof live loads* of 30 pounds per square foot (1.44 kN/m$^2$) or less need not be combined with seismic load. Where flat roof snow *loads* exceed 30 pounds per square foot (1.44 kN/m$^2$), 20 percent shall be combined with seismic loads.
3. Where the allowable stress design load combinations of ASCE 7 Section 2.4 are used, crane hook loads need not be combined with roof live loads or with more than three-fourths of the snow load or one-half of the wind loads.

**1610.2 [Soil loads and hydrostatic pressure] Uplift loads on floor and foundations.** Basement floors, slabs on ground, foundations, and similar approximately horizontal elements below grade shall be designed to resist uplift *loads* where applicable. The upward pressure of water shall be taken as the full hydrostatic pressure applied over the entire area. The hydrostatic *load* shall be measured from the underside of the element being evaluated. The design for upward *loads* caused by expansive soils shall comply with Section 1808.6.

## SECTION 1612 FLOOD LOADS

**1612.1 General.** Within *flood hazard areas* as established in Section 1612.3, all new construction of buildings, structures and portions of buildings and structures, including *substantial improvement* and restoration of *substantial damage* to buildings and structures, shall be designed and constructed to resist the effects of flood hazards and *flood loads*. For buildings that are located in more than one *flood hazard area*, the provisions associated with the most restrictive *flood hazard area* shall apply.

**1612.2 Design and construction.** The design and construction of buildings and structures located in *flood hazard areas*, including *coastal high hazard areas* and *coastal A zones*, shall be in accordance with Chapter 5 of ASCE 7 and ASCE 24.

**1612.3 Establishment of flood hazard areas.** To establish *flood hazard areas*, the applicable governing authority shall adopt a flood hazard map and supporting data. The flood hazard map shall include, at a minimum, areas of special flood hazard as identified by the Federal Emergency Management Agency in an engineering report entitled "The *Flood Insurance Study* for **[INSERT NAME OF JURISDICTION]**," dated **[INSERT DATE OF ISSUANCE]**, as amended or revised with the accompanying *Flood Insurance Rate Map* (FIRM) and Flood Boundary and Floodway Map (FBFM) and related supporting data along with any revisions thereto. The adopted flood hazard map and supporting data are hereby adopted by reference and declared to be part of this section.

**1612.3.1 Design flood elevations.** Where *design flood elevations* are not included in the *flood hazard areas* established in Section 1612.3, or where *floodways* are not designated, the *building official* is authorized to require the applicant to do one of the following:

1. Obtain and reasonably utilize any *design flood elevation* and *floodway* data available from a federal, state or other source.
2. Determine the *design flood elevation* or *floodway* in accordance with accepted hydrologic and hydraulic engineering practices used to define *special flood hazard areas*. Determinations shall be undertaken by a *registered design professional* who shall document that the technical methods used reflect currently accepted engineering practice.

**1612.3.2 Determination of impacts.** In riverine *flood hazard areas* where *design flood elevations* are specified but *floodways* have not been designated, the applicant shall provide a *floodway* analysis that demonstrates that the proposed work will not increase the *design flood elevation* more than 1 foot (305 mm) at any point within the jurisdiction of the applicable governing authority.

**1612.4 Flood hazard documentation.** The following documentation shall be prepared and sealed by a *registered design professional* and submitted to the *building official*:

1. For construction in *flood hazard areas* other than *coastal high hazard areas* or *coastal A zones*:
   1.1. The elevation of the *lowest floor*, including the basement, as required by the lowest floor elevation inspection in Section 110.3.3 and for the final inspection in Section 110.3.12.1.
   1.2. 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 2.7.2.1 of ASCE 24, *construction documents* shall include a statement that the design will provide for equalization of hydrostatic flood forces in accordance with Section 2.7.2.2 of ASCE 24.
   1.3. For *dry floodproofed* nonresidential buildings, *construction documents* shall include a statement that the *dry floodproofing* is designed in accordance with ASCE 24 and shall include the flood emergency plan specified in Chapter 6 of ASCE 24.
2. For construction in *coastal high hazard areas* and *coastal A zones*:

2.1. The elevation of the bottom of the lowest horizontal structural member as required by the *lowest floor* elevation inspection in Section 110.3.3 and for the final inspection in Section 110.3.12.1.

2.2. *Construction documents* shall include a statement that the building is designed in accordance with ASCE 24, including that the pile or column foundation and building or structure to be attached thereto is designed to be anchored to resist flotation, collapse and lateral movement due to the effects of wind and flood loads acting simultaneously on all building components, and other load requirements of Chapter 16.

2.3. For breakaway walls designed to have a resistance of more than 20 psf (0.96 kN/m2) determined using *allowable stress design*, *construction documents* shall include a statement that the breakaway wall is designed in accordance with ASCE 24.

2.4. For breakaway walls where provisions to allow for the automatic entry and exit of floodwaters do not meet the minimum requirements in Section 2.7.2.1 of ASCE 24, construction documents shall include a statement that the design will provide for equalization of hydrostatic flood forces in accordance with Section 2.7.2.2 of ASCE 24.

## CHAPTER 18 SOILS AND FOUNDATIONS

**1801.1 Scope.** The provisions of this chapter shall apply to building and foundation systems.

**1804.4 [Excavation, Grading and Fill] Site grading.** The ground immediately adjacent to the foundation shall be sloped away from the building at a slope of not less than one unit vertical in 20 units horizontal (5-percent slope) for a minimum distance of 10 feet (3048 mm) measured perpendicular to the face of the wall. If physical obstructions or lot lines prohibit 10 feet (3048 mm) of horizontal distance, a 5-percent slope shall be provided to an *approved* alternative method of diverting water away from the foundation. Swales used for this purpose shall be sloped not less than 2 percent where located within 10 feet (3048 mm) of the building foundation. Impervious surfaces within 10 feet (3048 mm) of the building foundation shall be sloped not less than 2 percent away from the building.

**Exceptions:**

1. Where climatic or soil conditions warrant, the slope of the ground away from the building foundation shall be permitted to be reduced to not less than one unit vertical in 48 units horizontal (2-percent slope).
2. Impervious surfaces shall be permitted to be sloped less than 2 percent where the surface is a door landing or ramp that is required to comply with Section 1010.1.5, 1012.3 or 1012.6.1.

The procedure used to establish the final ground level adjacent to the foundation shall account for additional settlement of the backfill.

**1804.5 [Excavation, Grading and Fill] Grading and fill in flood hazard areas.** In *flood hazard areas* established in Section 1612.3, grading, fill, or both, shall not be *approved*:

1. Unless such fill is placed, compacted and sloped to minimize shifting, slumping and erosion during the rise and fall of *flood* water and, as applicable, wave action.

2. In *floodways*, unless it has been demonstrated through hydrologic and hydraulic analyses performed by a *registered design professional* in accordance with standard engineering practice that the proposed grading or fill, or both, will not result in any increase in *flood* levels during the occurrence of the *design flood*.
3. In *coastal high hazard areas*, unless such fill is conducted or placed to avoid diversion of water and waves toward any building or structure.
4. Where *design flood elevations* are specified but *floodways* have not been designated, unless it has been demonstrated that the cumulative effect of the proposed *flood hazard area* encroachment, when combined with all other existing and anticipated *flood hazard area* encroachment, will not increase the *design flood elevation* more than 1 foot (305 mm) at any point.

**1805.1.2.1 [Under-floor space] Flood hazard areas.** For buildings and structures in *flood hazard areas* as established in Section 1612.3, the finished ground level of an under-floor space such as a crawl space shall be equal to or higher than the outside finished ground level on one side or more.

**Exception:** Under-floor spaces of Group R-3 buildings that meet the requirements of FEMA TB 11.

## CHAPTER 27 ELECTRICAL

**[F] 2702.1.8 Group I-2 Occupancies.** In Group I-2 occupancies located in flood hazard areas established in Section 1612.3, where new essential electrical systems are installed, and where new essential electrical system generators are installed, the systems and generators shall be located and installed in accordance with ASCE 24. Where connections for hookup of temporary generators are provided, the connections shall be located at or above the elevation required in ASCE 24.

## CHAPTER 30 ELEVATORS AND CONVEYING SYSTEMS

**3001.3 Referenced standards.** Except as otherwise provided for in this code, the design, construction, installation, alteration, repair and maintenance of elevators and conveying systems and their components shall conform to the applicable standard specified in Table 3001.3 and ASCE 24 for construction in *flood hazard areas* established in Section 1612.3.

## CHAPTER 31 SPECIAL CONSTRUCTION

**3102.7 [Membrane Structures] Engineering design.** The structure shall be designed and constructed to sustain *dead loads*; loads due to tension or inflation; *live loads* including wind, snow or *flood* and seismic loads and in accordance with Chapter 16.

**3109.1 [Swimming Pools, Spas and Hot Tubs] General.** The design and construction of swimming pools, spas and hot tubs shall comply with the *International Swimming Pool and Spa Code*.

### SECTION 3114 PUBLIC USE RESTROOM BUILDINGS IN FLOOD HAZARD AREAS

**3114.1 General.** For the purpose of this section, public restroom buildings are located on publicly owned lands in *flood hazard areas* and intended for public use. Public restroom buildings and portions of other buildings that contain public restrooms, are limited to toilet rooms, bathrooms, showers and changing rooms, and those portions

of buildings that contain toilet rooms, bathrooms, showers and changing rooms. Public restroom buildings and portions of buildings that contain public restrooms shall comply with the requirements of this section. Public use restrooms that are not elevated or *dry floodproofed* in accordance with Section 1612 shall comply with Section 3114.2. Portions of buildings that include uses other than public-use toilet rooms, bathrooms, showers and changing rooms shall comply with Section 1612.

**3114.2 Flood resistance.** Public-use restrooms on publicly owned lands in *flood hazard areas* shall comply with the requirements of ASCE 24, except for elevation requirements, and shall comply with all of the following criteria:

1. The building footprint is not more than 1,500 square feet (139m$^2$).
2. Located, designed and constructed to resist the effects of *flood* hazards and *flood loads* to minimize *flood* damage from a combination of wind and water *loads* associated with the *base flood*.
3. Anchored to prevent flotation, collapse or lateral movement resulting from hydrodynamic and hydrostatic *loads*, including the effects of buoyancy during conditions of the *base flood*.
4. Constructed of *flood-damage-resistant materials*.
5. Where enclosed by walls, the walls have flood openings.
6. Mechanical and electrical systems are located above the *base flood elevation*.
7. Plumbing fixtures and plumbing connections are located above the *base flood elevation*.
8. An emergency plan, approved by the jurisdiction, is submitted to the building official and includes building design documents specifying implementation of protection measures prior to the onset of *flooding* conditions.

   **Exceptions:**

   1. Minimum necessary electric equipment required to address health, life safety and electric code requirements is permitted below the *base flood elevation* in accordance with ASCE 24 provisions for electric elements installed below the minimum elevations.
   2. Plumbing fixtures and connections are permitted below the *base flood elevation* provided that the fixtures and connections are designed and installed to minimize or eliminate infiltration of floodwaters into the sanitary sewage system and discharges from sanitary sewage systems into floodwaters.

## CHAPTER 34 RESERVED

*Action taken during the 2012 Code Development Process removed Chapter 34, Existing Structure, from the IBC. The provisions of this chapter are contained in the IEBC. See Section 101.4.7.*

## CHAPTER 35 REFERENCED STANDARDS

ASCE/SEI 7-16 with Supplement 1. Minimum Design Loads and Associated Criteria for Buildings and Other Structures

ASCE/SEI 24-14 Flood Resistant Design and Construction. 1202.4.2, 1202.4.4; 1612.2; 1612.4; 2702.1.8; 3001.3

FEMA-TB-11-01. Crawlspace Construction for Buildings Located in Special Flood Hazard Areas. 1805.1.2.1

# APPENDIX G FLOOD-RESISTANT CONSTRUCTION

*The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance.*

**User notes:**

*About this appendix: Appendix G is intended to provide the additional flood-plain management and administrative requirements of the National Flood Insurance Program (NFIP) that are not included in the code. Communities that adopt the International Building Code and Appendix G will meet the minimum requirements of the NFIP as set forth in Title 44 of the Code of Federal Regulations.*

*Code development reminder: Code change proposals to this appendix will be considered by he IBC-Structural Code Development Committee during the 2022 (Group B) Code Development Cycle.*

## SECTION G101 ADMINISTRATION

**G101.1 Purpose.** The purpose of this appendix is to promote the public health, safety and general welfare and to minimize public and private losses due to flood conditions in specific *flood hazard areas* through the establishment of comprehensive regulations for management of *flood hazard areas* designed to:

1. Prevent unnecessary disruption of commerce, access and public service during times of flooding.
2. Manage the alteration of natural flood plains, stream channels and shorelines.
3. Manage filling, grading, dredging and other development that may increase flood damage or erosion potential.
4. Prevent or regulate the construction of flood barriers that will divert floodwaters or that can increase flood hazards.
5. Contribute to improved construction techniques in the flood plain.

**G101.2 Objectives.** The objectives of this appendix are to protect human life, minimize the expenditure of public money for flood control projects, minimize the need for rescue and relief efforts associated with *flooding*, minimize prolonged business interruption, minimize damage to public facilities and utilities, help maintain a stable tax base by providing for the sound use and development of flood-prone areas, contribute to improved construction techniques in the flood plain and ensure that potential owners and occupants are notified that property is within *flood hazard areas*.

**G101.3 Scope.** The provisions of this appendix shall apply to all proposed development in a *flood hazard area* established in Section 1612 of this code, including certain building work exempt from permit under Section 105.2.

**G101.4 Violations.** Any violation of a provision of this appendix, or failure to comply with a *permit* or variance issued pursuant to this appendix or any requirement of this appendix, shall be handled in accordance with Section 114.

**G101.5 Designation of floodplain administrator.** The **[INSERT JURISDICTION'S SELECTED POSITION TITLE]** is designated as the floodplain administrator and is authorized and directed to enforce the provisions of this appendix.

The floodplain administrator is authorized to delegate performance of certain duties to other employees of the jurisdiction. Such designation shall not alter any duties and powers of the building official.

## SECTION G102 DEFINITIONS

**G102.1 General.** The following words and terms shall, for the purposes of this appendix, have the meanings shown herein. Refer to Chapter 2 of this code for general definitions.

**DEVELOPMENT.** Any man-made change to improved or unimproved real estate, including but not limited to, buildings or *other structures*, temporary structures, temporary or permanent storage of materials, mining, dredging, filling, grading, paving, excavations, operations and other land-disturbing activities.

**FUNCTIONALLY DEPENDENT FACILITY.** A facility that cannot perform its intended purpose unless it is located or carried out in close proximity to water. The term includes only docking facilities, port facilities necessary for the loading or unloading of cargo or passengers, and shipbuilding and ship repair facilities. The term does not include long-term storage, manufacture, sales or service facilities.

**MANUFACTURED HOME.** A structure that is transportable in one or more sections, built on a permanent chassis, designed for use with or without a permanent foundation when attached to the required utilities, and constructed to the Federal Manufactured Home Construction and Safety Standards and rules and regulations promulgated by the U.S. Department of Housing and Urban Development. The term also includes mobile homes, park trailers, travel trailers and similar transportable structures that are placed on a site for 180 consecutive days or longer.

**MANUFACTURED HOME PARK OR SUBDIVISION.** A parcel (or contiguous parcels) of land divided into two or more manufactured home lots for rent or sale.

**RECREATIONAL VEHICLE.** A vehicle that is built on a single chassis, 400 square feet (37.16 $m^2$) or less when measured at the largest horizontal projection, designed to be self-propelled or permanently towable by a light-duty truck, and designed primarily not for use as a permanent dwelling but as temporary living quarters for recreational, camping, travel or seasonal use. A recreational vehicle is ready for highway use if it is on its wheels or jacking system, is attached to the site only by quick disconnect-type utilities and security devices and has no permanently attached additions.

**VARIANCE.** A grant of relief from the requirements of this section that permits construction in a manner otherwise prohibited by this section where specific enforcement would result in unnecessary hardship.

**VIOLATION.** A development that is not fully compliant with this appendix or Section 1612, as applicable.

## SECTION G103 APPLICABILITY

**G103.1 General.** This appendix, in conjunction with this code, provides minimum requirements for development located in *flood hazard areas*, including:

1. The subdivision of land.
2. Site improvements and installation of utilities.

3. Placement and replacement of manufactured homes.
4. Placement of recreational vehicles.
5. New construction and repair, reconstruction, rehabilitation or additions to new construction.
6. *Substantial improvement* of existing buildings and structures, including restoration after damage.
7. Installation of tanks.
8. Temporary structures.
9. Temporary or permanent storage, utility and miscellaneous Group U buildings and structures.
10. Certain building work exempt from permit under Section 105.2 and other buildings and development activities.

**G103.2 Establishment of flood hazard areas.** *Flood hazard areas* are established in Section 1612.3 of this code, adopted by the applicable governing authority on **[INSERT DATE].**

## SECTION G104 POWERS AND DUTIES

**G104.1 Permit Applications.** All applications for permits shall comply with the following:

1. The floodplain administrator shall review all *permit* applications to determine whether proposed development is located in *flood hazard areas* established in Section G103.2.
2. Where a proposed development site is in a *flood hazard area*, all development to which this appendix is applicable as specified in Section G103.1 shall be designed and constructed with methods, practices and materials that minimize *flood* damage and that are in accordance with this code and ASCE 24.

**G104.2 Other permits.** It shall be the responsibility of the floodplain administrator to ensure that approval of a proposed development shall not be given until proof that necessary permits have been granted by federal or state agencies having jurisdiction over such development.

**G104.3 Determination of design flood elevations.** If *design flood elevations* are not specified, the floodplain administrator is authorized to require the applicant to meet one of the following:

1. Obtain, review and reasonably utilize data available from a federal, state or other source.
2. Determine the *design flood elevation* in accordance with accepted hydrologic and hydraulic engineering techniques. Such analyses shall be performed and sealed by a *registered design professional*. Studies, analyses and computations shall be submitted in sufficient detail to allow review and approval by the floodplain administrator. *The accuracy of data submitted for such determination shall be the responsibility of the applicant.*

**G104.4 Activities in riverine flood hazard areas.** In riverine *flood hazard areas* where *design flood elevations* are specified but *floodways* have not been designated, the floodplain administrator shall not permit any new construction, *substantial improvement* or other development, including fill, unless the applicant submits an engineering analysis prepared by a *registered design professional*, demonstrating that the cumulative effect of the proposed development, when combined with all other existing and anticipated *flood hazard area* encroachment, will not increase the *design flood elevation* more than 1 foot (305 mm) at any point within the community.

**G104.5 Floodway encroachment.** Prior to issuing a *permit* for any *floodway* encroachment, including fill, new construction, *substantial improvements* and other development or land-disturbing activity, the floodplain administrator shall require submission of a certification, prepared by a *registered design professional*, along with supporting technical data, demonstrating that such development will not cause any increase of the *base flood* level.

**G104.5.1 Floodway revisions.** A *floodway* encroachment that increases the level of the *base flood* is authorized if the applicant has applied for a conditional *Flood Insurance Rate Map* (FIRM) revision and has received approval of the Federal Emergency Management Agency (FEMA).

**G104.6 Watercourse alteration.** Prior to issuing a *permit* for any alteration or relocation of any watercourse, the floodplain administrator shall require the applicant to provide notification of the proposal to the appropriate authorities of all adjacent government jurisdictions, as well as appropriate state agencies. A copy of the notification shall be maintained in the permit records and submitted to FEMA.

**G104.6.1 Engineering analysis.** The floodplain administrator shall require submission of an engineering analysis, prepared by a *registered design professional*, demonstrating that the flood-carrying capacity of the altered or relocated portion of the watercourse will not be decreased. Such watercourses shall be maintained in a manner that preserves the channel's flood-carrying capacity.

**G104.7 Alterations in coastal areas.** Prior to issuing a *permit* for any alteration of sand dunes and mangrove stands in *coastal high-hazard areas* and coastal A zones, the floodplain administrator shall require submission of an engineering analysis, prepared by a *registered design professional*, demonstrating that the proposed alteration will not increase the potential for flood damage.

**G104.8 Records.** The floodplain administrator shall maintain a permanent record of all *permits* issued in *flood hazard areas*, including supporting certifications and documentation required by this appendix and copies of inspection reports, design certifications and documentation of elevations required in Section 1612 of this code and Section R322 of the *International Residential Code*.

**G104.9 Inspections.** Development for which a *permit* under this appendix is required shall be subject to inspection. The floodplain administrator or the floodplain administrator's designee shall make, or cause to be made, inspections of all development in *flood hazard areas* authorized by issuance of a *permit* under this appendix.

**G104.10 Use of changed technical data.** The floodplain administrator and the applicant shall not use changed *flood hazard area* boundaries or base flood elevations for proposed buildings or development until the floodplain administrator or applicant has applied for a conditional *Flood Insurance Rate Map* (FIRM) revision and has received the approval of the Federal Emergency Management Agency (FEMA).

## SECTION G105 PERMITS

**G105.1 Required.** Any person, owner or owner's authorized agent who intends to conduct any development in a *flood hazard area* shall first make application to the floodplain administrator and shall obtain the required *permit*.

**G105.2 Application for permit.** The applicant shall file an application in writing on a form furnished by the floodplain administrator. Such application shall:

1. Identify and describe the development to be covered by the *permit*.
2. Describe the land on which the proposed development is to be conducted by legal description, street address or similar description that will readily identify and definitely locate the site.
3. Include a site plan showing the delineation of *flood hazard areas*, *floodway* boundaries, *flood* zones, *design flood elevations*, ground elevations, proposed fill and excavation and drainage patterns and facilities.
4. Include in subdivision proposals and other proposed developments with more than 50 lots or larger than 5 acres (20 234 $m^2$), *base flood elevation* data in accordance with Section 1612.3.1 if such data are not identified for the *flood hazard areas* established in Section G103.2.
5. Indicate the use and occupancy for which the proposed development is intended.
6. Be accompanied by construction documents, grading and filling plans and other information deemed appropriate by the floodplain administrator.
7. State the valuation of the proposed work.
8. Be signed by the applicant or the applicant's authorized agent.

**G105.3 Validity of permit.** The issuance of a *permit* under this appendix shall not be construed to be a *permit* for, or approval of, any violation of this appendix or any other ordinance of the jurisdiction. The issuance of a *permit* based on submitted documents and information shall not prevent the floodplain administrator from requiring the correction of errors. The floodplain administrator is authorized to prevent occupancy or use of a structure or site that is in violation of this appendix or other ordinances of this jurisdiction.

**G105.4 Expiration.** A *permit* shall become invalid if the proposed development is not commenced within 180 days after its issuance, or if the work authorized is suspended or abandoned for a period of 180 days after the work commences. Extensions shall be requested in writing and justifiable cause demonstrated. The floodplain administrator is authorized to grant, in writing, one or more extensions of time, for periods not more than 180 days each.

**G105.5 Suspension or revocation.** The floodplain administrator is authorized to suspend or revoke a *permit* issued under this appendix wherever the *permit* is issued in error or on the basis of incorrect, inaccurate or incomplete information, or in violation of any ordinance or code of this jurisdiction.

## SECTION G106 VARIANCES

**G106.1 General.** The *board of appeals* established pursuant to Section 113, or other established or designated board, shall hear and decide requests for variances. The *board* shall base its determination on technical justifications, and has the right to attach such conditions to variances as it deems necessary to further the purposes and objectives of this appendix and Section 1612.

**G106.2 Records.** The floodplain administrator shall maintain a permanent record of all variance actions, including justification for their issuance.

**G106.3 Historic structures.** A variance is authorized to be issued for the repair or rehabilitation of a historic structure upon a determination that the proposed repair or rehabilitation will not preclude the structure's continued

designation as a historic structure, and the variance is the minimum necessary to preserve the historic character and design of the structure.

**Exception:** Within *flood hazard areas*, historic structures that do not meet one or more of the following designations:

1. Listed or preliminarily determined to be eligible for listing in the National Register of Historic Places.
2. Determined by the Secretary of the U.S. Department of Interior as contributing to the historical significance of a registered historic district or a district preliminarily determined to qualify as an historic district.
3. Designated as *historic* under a state or local historic preservation program that is approved by the Department of Interior.

**G106.4 Functionally dependent facilities.** A variance is authorized to be issued for the construction or substantial improvement of a functionally dependent facility provided the criteria in Section 1612.1 are met and the variance is the minimum necessary to allow the construction or *substantial improvement*, and that all due consideration has been given to methods and materials that minimize *flood* damages during the *design flood* and create no additional threats to public safety.

**G106.5 Restrictions.** The *board* shall not issue a variance for any proposed development in a floodway if any increase in flood levels would result during the *base flood* discharge.

**G106.6 Considerations.** In reviewing applications for variances, the board shall consider all technical evaluations, all relevant factors, all other portions of this appendix and the following:

1. The danger that materials and debris may be swept onto other lands resulting in further injury or damage.
2. The danger to life and property due to *flooding* or erosion damage.
3. The susceptibility of the proposed development, including contents, to *flood* damage and the effect of such damage on current and future owners.
4. The importance of the services provided by the proposed development to the community.
5. The availability of alternate locations for the proposed development that are not subject to *flooding* or erosion.
6. The compatibility of the proposed development with existing and anticipated development.
7. The relationship of the proposed development to the comprehensive plan and flood plain management program for that area.
8. The safety of access to the property in times of *flood* for ordinary and emergency vehicles.
9. The expected heights, velocity, duration, rate of rise and debris and sediment transport of the floodwaters and the effects of wave action, if applicable, expected at the site.
10. The costs of providing governmental services during and after *flood* conditions including maintenance and repair of public utilities and facilities such as sewer, gas, electrical and water systems, streets and bridges.

**G106.7 Conditions for issuance.** Variances shall only be issued by the board where all of the following criteria are met:

1. A technical showing of good and sufficient cause that the unique characteristics of the size, configuration or topography of the site renders the elevation standards inappropriate.
2. A determination that failure to grant the variance would result in exceptional hardship by rendering the lot undevelopable.
3. A determination that the granting of a variance will not result in increased *flood* heights, additional threats to public safety, extraordinary public expense, nor create nuisances, cause fraud on or victimization of the public or conflict with existing local laws or ordinances.
4. A determination that the variance is the minimum necessary, considering the *flood* hazard, to afford relief.
5. Notification to the applicant in writing over the signature of the floodplain administrator that the issuance of a variance to construct a structure below the *base flood* level will result in increased premium rates for flood insurance up to amounts as high as $25 for $100 of insurance coverage, and that such construction below the *base flood* level increases risks to life and property.

## SECTION G107 SUBDIVISIONS

**G107.1 General.** Any subdivision proposal, including proposals for manufactured home parks and subdivisions, or other proposed new development in a *flood hazard area* shall be reviewed to verify all of the following:

1. All such proposals are consistent with the need to minimize *flood* damage.
2. All public utilities and facilities, such as sewer, gas, electric and water systems, are located and constructed to minimize or eliminate *flood* damage.
3. Adequate drainage is provided to reduce exposure to *flood* hazards.

**G107.2 Subdivision requirements.** The following requirements shall apply in the case of any proposed subdivision, including proposals for manufactured home parks and subdivisions, any portion of which lies within a *flood hazard area*:

1. The *flood hazard area*, including *floodways*, and *coastal high-hazard areas* and coastal A zones, as appropriate, shall be delineated on tentative and final subdivision plats.
2. *Design flood elevations* shall be shown on tentative and final subdivision plats.
3. Residential building lots shall be provided with adequate buildable area outside the *floodway*.
4. The design criteria for utilities and facilities set forth in this appendix and appropriate International Codes shall be met.

## SECTION G108 SITE IMPROVEMENT

**G108.1 Development in floodways.** Development or land-disturbing activity shall not be authorized in the *floodway* unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practice, and prepared by a *registered design professional*, that the proposed encroachment will not result in any increase in the *base flood* level.

**G108.2 Coastal high-hazard areas and coastal A zones.** In *coastal high-hazard areas* and coastal A zones:

1. New buildings and buildings that are substantially improved shall only be authorized landward of the reach of mean high tide.
2. The use of fill for structural support of buildings is prohibited.

**G108.3 Sewer facilities.** All new or replaced sanitary sewer facilities, private sewage treatment plants (including all pumping stations and collector systems) and on-site waste disposal systems shall be designed in accordance with Chapter 7, ASCE 24, to minimize or eliminate infiltration of floodwaters into the facilities and discharge from the facilities into floodwaters, or impairment of the facilities and systems.

**G108.4 Water facilities.** All new or replacement water facilities shall be designed in accordance with the provisions of Chapter 7, ASCE 24, to minimize or eliminate infiltration of floodwaters into the systems.

**G108.5 Storm drainage.** Storm drainage shall be designed to convey the flow of surface waters to minimize or eliminate damage to persons or property.

**G108.6 Streets and sidewalks.** Streets and sidewalks shall be designed to minimize potential for increasing or aggravating *flood* levels.

## SECTION G109 MANUFACTURED HOMES

**G109.1 Elevation.** All new and replacement manufactured homes to be placed or substantially improved in a *flood hazard area* shall be elevated such that the *lowest floor* of the manufactured home is elevated to or above the *design flood elevation*.

**G109.2 Foundations.** All new and replacement manufactured homes, including *substantial improvement* of existing manufactured homes, shall be placed on a permanent, reinforced foundation that is designed in accordance with Section R322 of the *International Residential Code*.

**G109.3 Anchoring.** All new and replacement manufactured homes to be placed or substantially improved in a *flood hazard area* shall be installed using methods and practices that minimize *flood* damage. Manufactured homes shall be securely anchored to an adequately anchored foundation system to resist flotation, collapse and lateral movement. Methods of anchoring are authorized to include, but are not limited to, use of over-the-top or frame ties to ground anchors. This requirement is in addition to applicable state and local anchoring requirements for resisting wind forces.

**G109.4 Protection of mechanical equipment and outside appliances.** Mechanical equipment and outside appliances shall be elevated to or above the *design flood elevation*.

> **Exception:** Where such equipment and appliances are designed and installed to prevent water from entering or accumulating within their components and the systems are constructed to resist hydrostatic and hydrodynamic loads and stresses, including the effects of buoyancy, during the occurrence of *flooding* up to the elevation required by Section R322 of the *International Residential Code*, the systems and equipment shall be permitted to be located below the elevation required by Section R322 of the *International Residential Code*. Electrical wiring systems shall be permitted below the *design flood elevation* provided that they conform to the provisions of NFPA 70.

**G109.5 Enclosures.** Fully enclosed areas below elevated manufactured homes shall comply with the requirements of Section R322 of the *International Residential Code*.

## SECTION G110 RECREATIONAL VEHICLES

**G110.1 Placement prohibited.** The placement of recreational vehicles shall not be authorized in *coastal high-hazard areas* and in *floodways*.

**G110.2 Temporary placement.** Recreational vehicles in *flood hazard areas* shall be fully licensed and ready for highway use, or shall be placed on a site for less than 180 consecutive days.

**G110.3 Permanent placement.** Recreational vehicles that are not fully licensed and ready for highway use, or that are to be placed on a site for more than 180 consecutive days, shall meet the requirements of Section G109 for manufactured homes.

## SECTION G111 TANKS

**G111.1 Tanks.** Underground and above-ground tanks shall be designed, constructed, installed and anchored in accordance with ASCE 24.

## SECTION G112 OTHER BUILDING WORK

**G112.1 Garages and accessory structures.** Garages and accessory structures shall be designed and constructed in accordance with ASCE 24.

**G112.2 Fences.** Fences in *floodways* that have the potential to block the passage of floodwaters, such as stockade fences and wire mesh fences, shall meet the requirement of Section G104.5.

**G112.3 Oil derricks.** Oil derricks located in *flood hazard areas* shall be designed in conformance with the *flood loads* in Sections 1603.1.7 and 1612.

**G112.4 Retaining walls, sidewalks and driveways.** Retaining walls, sidewalks and driveways shall meet the requirements of Section 1804.5.

**G112.5 Swimming pools.** Swimming pools shall be designed and constructed in accordance with ASCE 24. Above-ground swimming pools, on-ground swimming pools and in-ground swimming pools that involve placement of fill in *floodways* shall also meet the requirements of Section G104.5.

**G112.6 Decks, porches, and patios.** Decks, porches and patios shall be designed and constructed in accordance with ASCE 24.

**G112.7 Nonstructural concrete slabs in coastal high-hazard areas and coastal A zones.** In *coastal high-hazard areas* and coastal A zones, *nonstructural concrete* slabs used as parking pads, enclosure floors, landings, decks, walkways, patios and similar nonstructural uses are permitted beneath or adjacent to buildings and structures provided that the concrete slabs shall be constructed in accordance with ASCE 24.

**G112.8 Roads and watercourse crossings in regulated floodways.** Roads and watercourse crossings that encroach into regulated *floodways*, including roads, bridges, culverts, low-water crossings and similar means for vehicles or pedestrians to travel from one side of a watercourse to the other, shall meet the requirement of Section G104.5.

## SECTION G113 TEMPORARY STRUCTURES AND TEMPORARY STORAGE

**G113.1 Temporary structures.** Temporary structures shall be erected for a period of less than 180 days. Temporary structures shall be anchored to prevent flotation, collapse or lateral movement resulting from hydrostatic *loads*, including the effects of buoyancy, during conditions of the *design flood*. Fully enclosed temporary structures shall have flood openings that are in accordance with ASCE 24 to allow for the automatic entry and exit of floodwaters.

**G113.2 Temporary storage.** Temporary storage includes storage of goods and materials for a period of less than 180 days. Stored materials shall not include hazardous materials.

**G113.3 Floodway encroachment.** Temporary structures and temporary storage in *floodways* shall meet the requirements of G104.5.

## SECTION G114 UTILITY AND MISCELLANEOUS GROUP U

**G114.1 Utility and miscellaneous Group U.** Utility and miscellaneous Group U includes buildings that are accessory in character and miscellaneous structures not classified in any specific occupancy in this code, including, but not limited to, *agricultural buildings*, aircraft hangars (accessory to a one- or two-family residence), barns, carports, fences more than 6 feet (1829 mm) high, grain silos (accessory to a residential occupancy), greenhouses, livestock shelters, private garages, retaining walls, sheds, stables and towers.

**G114.2 Flood loads.** Utility and miscellaneous Group U buildings and structures, including *substantial improvement* of such buildings and structures, shall be anchored to prevent flotation, collapse or lateral movement resulting from *flood loads*, including the effect of buoyancy, during conditions of the *design flood*.

**G114.3 Elevation.** Utility and miscellaneous Group U buildings and structures, including *substantial improvement* of such buildings and structures, shall be elevated such that the *lowest floor*, including basement, is elevated to or above the *design flood elevation* in accordance with Section 1612 of this code.

**G114.4 Enclosures below design flood elevation.** Fully enclosed areas below the *design flood elevation* shall be constructed in accordance with ASCE 24.

**G114.5 Flood-damage-resistant materials.** Flood-damage-resistant materials shall be used below the *design flood elevation*.

**G114.6 Protection of mechanical, plumbing and electrical systems.** Mechanical, plumbing and electrical systems, including plumbing fixtures, shall be elevated to or above the *design flood elevation*.

> **Exception:** Electrical systems, equipment and components; heating, ventilating, air conditioning and plumbing appliances; plumbing fixtures, duct systems and other service equipment shall be permitted to be located below the *design flood elevation* provided that they are designed and installed to prevent water from entering or accumulating within the components and to resist hydrostatic and hydrodynamic loads and stresses, including

the effects of buoyancy, during the occurrence of flooding to the *design flood elevation* in compliance with the flood-resistant construction requirements of this code. Electrical wiring systems shall be permitted to be located below the *design flood elevation* provided they conform to the provisions of NFPA 70.

### SECTION G115 REFERENCED STANDARDS

**G115.1 General.** See Table G115.1 for standards that are referenced in various sections of this appendix. Standards are listed by the standard identification with the effective date, standard title, and the section or sections of this appendix referenced in the standard.

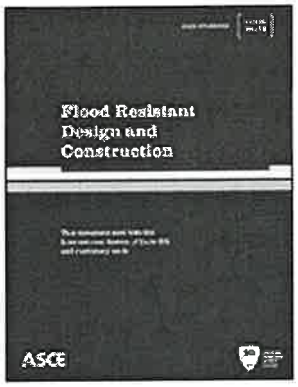
**Table G115.1 REFERENCED STANDARDS**

| STANDARD ACRONYM | STANDARD NAME | SECTIONS HEREIN REFERENCED |
|---|---|---|
| ASCE 24–14 | *Flood Resistant Design and Construction* | G104.1, G108.3, G108.4, G111.1, G112.1, G122.5, G112.6, G112.7, G113.1, G114.4 |
| HUD 24 CFR Part 3285 (2008) | *Manufactured Home Construction and Safety Standards* | G102 |
| IBC–21 | *International Building Code®* | G103.2, G114.1, G114.3 |
| IRC–21 | *International Residential Code®* | G109.2, G109.4, G109.5 |
| NFPA 70–20 | *National Electrical Code®* | G109.4, G114.6 |

## APPENDIX J GRADING

**J101.2 Flood hazard areas.** Unless the applicant has submitted an engineering analysis, prepared in accordance with standard engineering practice by a *registered design professional*, that demonstrates the proposed work will not result in any increase in the level of the *base flood*, grading, excavation and earthwork construction, including fills and embankments, shall not be permitted in *floodways* that are in *flood hazard areas* established in Section 1612.3 or in *flood hazard areas* where *design flood elevations* are specified but *floodways* have not been designated.

## HIGHLIGHTS OF ASCE 24-14 *Flood Resistant Design and Construction*




Published by the American Society of Civil Engineers (ASCE), *Flood Resistant Design and Construction,* ASCE 24, is a referenced standard in the *International Codes*® (I-Codes®). ASCE 24 states the minimum requirements and expected performance for the siting and design and construction of buildings and structures in flood hazard areas that are subject to building code requirements. Types of buildings and structures are described in ASCE 24-14, Table 1-1 (see page 5 of these Highlights), and include commercial, residential, industrial, educational, healthcare, critical facilities, and other occupancy types. Buildings and structures designed according to ASCE 24 are better able to resist flood loads and flood damage.

FEMA deems ASCE 24 to meet or exceed the minimum National Flood Insurance Program (NFIP) requirements for buildings and structures. ASCE 24 includes additional specificity, some additional requirements, and some limitations that are not in NFIP regulations.

Buildings and structures within the scope of the IBC and proposed to be located in any flood hazard area must be designed in accordance with ASCE 24. The 2015 I-Codes reference ASCE 24-14, while the 2006 through 2012 I-Codes reference ASCE 24-05. The *International Residential Code*® requires dwellings in floodways to be designed in accordance with ASCE 24, and the 2015 edition of the IRC allows use of ASCE 24 for dwellings in any flood hazard area (the 2012 and 2009 editions allow use of ASCE 24 in Coastal High Hazard Areas).

Highlights of ASCE 24-14 that complement the NFIP minimum requirements are described below.

A summary of significant technical revisions from ASCE 24-05 to ASCE 24-14 is reproduced on page 6 of these Highlights.

### Building Performance

- Flood loads and other loads and load combinations are specified in ASCE 7-10, *Minimum Design Loads for Buildings and Other Structures*. Performance of foundations exposed to flooding is specified in ASCE 24. Soil characteristics and underlying strata, including soil consolidation, expansion or movement, erosion and scour, liquefaction and subsidence must be considered, as applicable.
- Flood Design Classes replace Occupancy/Risk Categories for the purpose of establishing elevations of lowest floors, flood-resistant materials, equipment and floodproofing. The 2015 *International Building Code* requires designers to identify the Flood Design Class assigned in accordance with ASCE 24-14.
- Elevation and Freeboard (additional height above the NFIP's base flood elevation) are specified as a function of the Flood Design Class and the nature of the flood hazard areas (see table on page 4 of these Highlights). Essential facilities (Flood Design Class 4) must be elevated or protected to the BFE + 2 ft or 500-year flood elevation, whichever is higher.
- Elevation requirements in Zone V and Coastal A Zones are independent of orientation of the lowest horizontal structural member (relative to direction of wave approach) as a factor in determining the required freeboard (ASCE 24-05 made elevation a function of orientation of the lowest horizontal structural member relative to the direction of wave approach).

ASCE 24 uses 'design flood' and 'design flood elevation' to acknowledge that some communities adopt flood hazard maps that depict flood hazard areas in addition to Special Flood Hazard Areas shown on FEMA's Flood Insurance Rate Maps (FIRM).

The design flood elevation (DFE) equals the base flood elevation (BFE) in communities that regulate based on FIRMs. The DFE is always equal to or higher than the BFE.

- Fill is required to be stable under conditions of flooding, including rapid rise and rapid drawdown, prolonged inundation, and erosion and scour. Compaction of structural fill is specified unless otherwise required by the building code or in a geotechnical or engineering report. Fill side slopes must be no steeper than 1:1.5.
- Two methods are specified to meet the requirements for flood openings in walls of enclosures below elevated buildings, to allow for the automatic entry and exit of floodwater: nonengineered openings that do not require certification (1 sq in per sq ft of enclosed area) and engineered openings that must be certified by a registered design professional. The performance of engineered openings must account for the presence of louvers, blades, screens, grilles, faceplates, or other covers and devices and must ensure that the difference between the exterior and interior floodwater levels does not exceed 1 foot. Installation of all flood openings must be in at least two walls and must be no more than 1 foot above the higher of the interior grade or floor and the finished exterior grade immediately under each opening.
- All breakaway walls in all flood hazard areas must have flood openings (ASCE 24-05 did not require flood openings in Zone V breakaway walls).
- Provisions are included for attached and detached decks and porches, and for garages, carports, and accessory storage structures.
- Provisions are listed for concrete slabs-on-grade, depending on the purpose and location of the slabs.
- Stairways and ramps must be designed and constructed to resist flood loads and to minimize transfer of flood loads to foundations, or to break away without causing damage to the main structure, or to be retractable/able to be raised.
- Where stairways are located inside areas enclosed with breakaway walls, exterior doors are required at the main building entry at the top of the stairs, to minimize entry of wind-driven rain and wave splash after breakaway walls have failed.
- In Coastal High Hazard Areas (Zone V) and Coastal A Zones:
  - Coastal A Zones are treated like Coastal High Hazard Areas if FEMA has delineated a Limit of Moderate Wave Action, or if the community has designated a Coastal A Zone.
  - Buildings must be supported on piles, drilled shafts, caissons, or other deep foundations (including columns, and shear walls) and foundation depth must take into account erosion and local scour.
  - Stem walls supporting floors and backfilled with soil or gravel are allowed in Coastal A Zones if designs provide for the effects of local scour and erosion.
  - Requirements are included for shallow foundations in circumstances where soil conditions prevent deep foundations.
  - Provisions are provided for pile foundations, attachment to piles, and different types of piles (wood, steel H, concrete-filled steel pipe, prestressed concrete, precast concrete, cast-in-place concrete).
  - Provisions are provided for pile design (capacity, capacity of supporting soils, minimum penetration, spacing, connections, splicing, and mixed and multiple types of piles).
  - Provisions are provided for footings, mats, rafts, slabs-on-grade, pile caps, grade beams, bracing, and shear walls.
  - Walls designed to break away must not produce debris that is capable of damaging structures.
  - Erosion control structures (bulkheads, seawalls, revetments) must not be attached to buildings or direct floodwater into or increase flood forces or erosion impacts on structures.
  - Pools must be elevated, or designed to breakaway without producing damaging debris, or designed to remain in the ground without obstructing flow that causes damage. Pools must be structurally independent of buildings and structures unless pools are located in or on elevated floors or roofs that are above the design flood elevation.

- Dry floodproofed nonresidential buildings and non-residential portions of mixed-use buildings:
  - The terms "mixed use" and "residential portions of mixed use" now are defined in Commentary.
  - Dry floodproofing measures are not permitted in Coastal High Hazard Areas, Coastal A Zones, High Risk Flood Hazard Areas, where flood velocities exceed 5 ft/sec, and where conformance with certain human intervention limits cannot be achieved.
  - At least one exit door or emergency escape/rescue opening must be provided above the elevation specified for dry floodproofing.
  - If dry floodproofing measures specified require human intervention to activate or implement, there must be a minimum warning time of 12 hours unless a community warning system provides a warning time sufficient to accomplish certain activities. If removable shields are approved as part of design, flood emergency plans must address specified elements and actions and must be posted in at least two conspicuous locations.

**Flood Damage-Resistant Materials**

- Flood damage-resistant materials must be used below specified elevations (see table on page 4).
- Metal connectors and fasteners exposed to salt water, salt spray or other corrosive agents must be stainless steel or equivalent corrosion resistant material, or hot-dipped galvanized after fabrication.
- Where preservative treated wood is required, treatment must be in accordance with AWPA requirements.

**Attendant Utilities and Equipment**

- Attendant utilities and equipment must be at or above specified elevations (see table on page 4), or must be specifically designed, constructed, and installed to prevent floodwaters from entering or accumulating within components.
- Fuel supply lines must be equipped with float operated automatic shut-off valves.
- Where required to meet life safety provisions of the code, certain exterior electrical components may be installed below the design flood elevation, provided they are installed on a non-breakaway structural element on the landward or downstream side of structures.
- Tanks that are below the design flood elevation and that are attached to or beneath buildings must be installed and anchored to resist at least 1.5 times the potential buoyant and other flood forces assumed to act on empty tanks.
- Elevator cabs that descend below the design flood elevation must be equipped with controls that prevent the cab from descending into floodwaters. Elevator shafts must be designed to resist flood loads, but are not required to have flood openings or breakaway walls.

**Siting Considerations**

- New buildings must not be built (1) seaward of the reach of mean high tide, or (2) in areas subject to flash flooding (floodwaters rise to 3 feet or more above banks in less than 2 hours). Unless protected, new buildings must not be built (1) in erosion-prone areas (determined by analysis); or (2) in mudslide areas (determined by analysis); or (3) in certain portions of alluvial fan areas; or (4) in high velocity flow areas (faster than 10 ft/sec); or (5) in ice jam and debris areas.
- Buildings in proximity to flood protective works (dams, levees, floodwalls, diversions, channels, flood control structures) must not have adverse effects on, or conflict with, maintenance and repairs of those protective works.

*Prepared by FEMA Building Science Branch. Content from ASCE 24-14 used with permission from ASCE.* Purchase ASCE 24 at www.asce.org.

*See next page for description of Flood Design Classes* ➔

| | | Flood Design Class 1 | Flood Design Class 2 | Flood Design Class 3 | Flood Design Class 4 |
|---|---|---|---|---|---|
| **Minimum Elevation* of Lowest Floor (Zone A: ASCE 24-14 Table 2-1)** | Zone A not identified as Coastal A Zone | DFE | BFE +1 ft or DFE, whichever is higher | BFE +1 ft or DFE, whichever is higher | BFE +2 ft or DFE, or 500-year flood elevation, whichever is higher |
| **Minimum Elevation of Bottom of Lowest Horizontal Structural Member (Zone V: ASCE 24-14 Table 4-1)** | Coastal High Hazard Areas (Zone V) and Coastal A Zone | DFE | BFE +1 ft or DFE, whichever is higher | BFE +2 ft or DFE, whichever is higher | BFE +2 ft or DFE, or 500-year flood elevation, whichever is higher |
| **Minimum Elevation Below Which Flood-Damage-Resistant Materials Shall be Used (Table ASCE 24-14 5-1)** | Zone A not identified as Coastal A Zone | DFE | BFE +1 ft or DFE, whichever is higher | BFE +1 ft or DFE, whichever is higher | BFE +2 ft or DFE, or 500-year flood elevation, whichever is higher |
| | Coastal High Hazard Areas (Zone V) and Coastal A Zone | DFE | BFE +1 ft or DFE, whichever is higher | BFE +2 ft or DFE, whichever is higher | BFE +2 ft or DFE, or 500-year flood elevation, whichever is higher |
| **Minimum Elevation** of Utilities and Equipment (ASCE 24-14 Table 7-1)** | Zone A not identified as Coastal A Zone | DFE | BFE +1 ft or DFE, whichever is higher | BFE +1 ft or DFE, whichever is higher | BFE +2 ft or DFE, or 500-year flood elevation, whichever is higher |
| | Coastal High Hazard Areas (Zone V) and Coastal A Zone | DFE | BFE +1 ft or DFE, whichever is higher | BFE +2 ft or DFE, whichever is higher | BFE +2 ft or DFE, or 500-year flood elevation, whichever is higher |
| **Minimum Elevation of Dry Floodproofing of non-residential structures and non-residential portions of mixed-use buildings (ASCE 24-14 Table 6-1)** | Zone A not identified as Coastal A Zone | BFE +1 ft or DFE, whichever is higher | BFE +1 ft or DFE, whichever is higher | BFE +1 ft or DFE, whichever is higher | BFE +2 ft or DFE, or 500-year flood elevation, whichever is higher |
| | Coastal High Hazard Areas (Zone V) and Coastal A Zone | Not permitted | Not permitted | Not permitted | Not permitted |
| **Minimum Elevation of Wet Floodproofing*** (ASCE 24-14 Table 6-1)** | Zone A not identified as Coastal A Zone; Coastal A Zone; Coastal High Hazard Areas (Zone V) | BFE +1 ft or DFE, whichever is higher | BFE +1 ft or DFE, whichever is higher | BFE +1 ft or DFE, whichever is higher | BFE +2 ft or DFE, or 500-year flood elevation, whichever is higher |

* Flood Design Class 1 structures shall be allowed below the minimum elevation if the structure meets the wet floodproofing requirements of ASCE 24-14 Section 6.3.
** Unless otherwise permitted by ASCE 24-14 Chapter 7
*** Only if permitted by ASCE 24-14 Section 6.3.1

| ASCE 24-14 Table 1-1 Flood Design Class of Buildings and Structures | |
|---|---|
| **Use or Occupancy of Buildings and Structures** | **Flood Design Class** |
| Buildings and structures that normally are unoccupied and pose minimal risk to the public or minimal disruption to the community should they be damaged or fail due to flooding. Flood Design Class 1 includes (1) temporary structures that are in place for less than 180 days, (2) accessory storage buildings and minor storage facilities (does not include commercial storage facilities), (3) small structures used for parking of vehicles, and (4) certain agricultural structures. [Note (a)] | 1 |
| Buildings and structures that pose a moderate risk to the public or moderate disruption to the community should they be damaged or fail due to flooding, except those listed as Flood Design Classes 1, 3, and 4. Flood Design Class 2 includes the vast majority of buildings and structures that are not specifically assigned another Flood Design Class, including most residential, commercial, and industrial buildings. | 2 |
| 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. Flood Design Class 3 includes (1) 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; (2) museums; (3) community centers and other recreational facilities; (4) athletic facilities with seating for spectators; (5) elementary schools, secondary schools, and buildings with college or adult education classrooms; (6) jails, correctional facilities, and detention facilities; (7) healthcare facilities not having surgery or emergency treatment capabilities; (8) care facilities where residents have limited mobility or ability, including nursing homes but not including care facilities for five or fewer persons; (9) preschool and child care facilities not located in one- and two-family dwellings; (10) 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; and (11) buildings and other structures not included in Flood Design Class 4 (including but not limited to facilities that manufacture, process, handle, store, use, or dispose of such substances as hazardous fuels, hazardous chemicals, hazardous waste, or explosives) containing toxic or explosive substances where the quantity of the material exceeds a threshold quantity established by the authority having jurisdiction and is sufficient to pose a threat to the public if released. [Note (b)] | 3 |
| 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. Flood Design Class 4 includes (1) hospitals and health care facilities having surgery or emergency treatment facilities; (2) fire, rescue, ambulance, and police stations and emergency vehicle garages; (3) designated emergency shelters; (4) designated emergency preparedness, communication, and operation centers and other facilities required for emergency response; (5) power generating stations and other public utility facilities required in emergencies; (6) critical aviation facilities such as control towers, air traffic control centers, and hangars for aircraft used in emergency response; (7) 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; and (8) buildings and other structures (including, but not limited to, facilities that manufacture, process, handle, store, use, or dispose of such substances as hazardous fuels, hazardous chemicals, or hazardous waste) containing sufficient quantities of highly toxic substances where the quantity of the material exceeds a threshold quantity established by the authority having jurisdiction and is sufficient to pose a threat to the public if released. [Note (b)] | 4 |
| [Note (a)] Certain agricultural structures may be exempt from some of the provisions of this standard; see ASCE 24-14 Section C1.4.3.<br>[Note (b)] Buildings and other structures containing toxic, highly toxic, or explosive substances shall be eligible for assignment to a lower Flood Design Class if it can be demonstrated to the satisfaction of the authority having jurisdiction by a hazard assessment as described in ASCE 7-10 Section 1.5.3 of *Minimum Design Loads for Buildings and Other Structures* that a release of the substances is commensurate with the risk associated with that Flood Design Class. | |

## Significant Technical Revisions

ASCE 24-14 lists a number of significant technical revisions from the 2005 edition:

1. Defines *Flood Design Class* rather than use Risk/Occupancy Classification assigned under ASCE 7 and requires each building or structure governed by the standard to be assigned to Flood Design Class 1, 2, 3, or 4. Uses the assigned Flood Design Class to apply elevation requirements specified in Chapters 2, 4, 5, 6 and 7. Flood Design Class 4 buildings and facilities are equivalent to Occupancy Category/Risk Category IV buildings, which ASCE 7-10 identifies as essential facilities.
2. Adds definitions for *Mixed Use* and *Residential Portions of Mixed Use* in commentary to clarify limitations on use of dry floodproofing measures.
3. Changes the Coastal A Zone determination requirement from the designer's responsibility to one depending on either: 1) delineation of a Limit of Moderate Wave Action (LiMWA) on a Flood Insurance Rate Map, or 2) designation by the Authority Having Jurisdiction.
4. Separates specifications for flood openings from the installation requirements. Requires the presence of louvers, blades, screens, faceplates, or other covers and devices to be accounted for in determining net open area for non-engineered openings and in determining the performance of engineered openings. Revises coefficient of discharge table for engineered flood openings. Adds commentary regarding selection of coefficient of discharge and for grouping or stacking of flood openings.
5. For Flood Design Class 4 buildings, requires the minimum lowest floor elevation (or floodproofing level of protection) to be the higher of: the Base Flood Elevation plus freeboard specified in Chapters 2, 4 and 6, the Design Flood Elevation, or the 500-year flood elevation. The 500-year flood elevation requirement is new.
6. Clarifies text pertaining to alluvial fan high risk flood hazard areas.
7. In coastal high hazard areas (V Zone) and Coastal A Zones (if delineated):
    a. Makes explicit that designs must account for local scour and erosion
    b. Provides for shallow foundations in Coastal A Zones under certain circumstances
    c. Requires flood openings in breakaway walls
    d. Eliminates orientation of the lowest horizontal structural member as a factor to determine elevation for lowest floors, equipment, and flood damage-resistant materials
    e. Requires exterior doors at the top of stairways that are located inside enclosed areas with breakaway walls
    f. Consolidates requirements for all nonstructural concrete slabs
    g. Allows substantial improvement of existing buildings seaward of the reach of mean high tide in V zones (makes ASCE 24 consistent with NFIP) and Coastal A Zones.
8. Updates flood damage-resistant material requirements.
9. Clarifies emergency escape and rescue opening requirements for dry floodproofed buildings.
10. Clarifies requirements for garages, carports, and accessory storage structures. Adds new section for multistory parking structures.
11. Consolidates requirements for tanks and more clearly distinguishes between requirements based on flood hazard area.