HIGHLIGHTS OF ASCE 24-05 *Flood Resistant Design and Construction*



ASCE 24 is a referenced standard in the *International Building Code*®. Any building or structure that falls within the scope of the IBC that is proposed in a flood hazard area is to be designed in accordance with ASCE 24. The *International Residential Code*® requires that dwellings in floodways be designed in accordance with ASCE 24, and the 2009 edition of the IRC will include an alternative that allows communities to require homes in V zones to be designed in accordance with ASCE 24. Purchase a copy of ASCE 24 at www.asce.org.

ASCE 24 tells the designer the minimum requirements and expected performance for the design and construction of buildings and structures in flood hazard areas. It is not a restatement of all of the NFIP regulations, but offers additional specificity, some additional requirements, and some limitations. Buildings designed according to ASCE 24 are better able to resist flood loads and flood damage.

Highlights of ASCE 24 that complement the NFIP minimum requirements include:

Building Performance

- Freeboard is required as a function of the nature of occupancy and the flood zone (see table below). Dwellings and most other buildings have 1-foot of freeboard; certain essential facilities have 2-3 feet; only agricultural facilities, temporary facilities and minor storage facilities are allowed to have their lowest floors at the BFE.
- Flood loads and other loads are those specified in ASCE 7.
- Performance of foundations exposed to flood loads and load combinations is specified; soil characteristics and underlying strata, including soil consolidation, expansion or movement, erosion and scour, liquefaction and subsidence must be considered.
- Fill is required to be stable under conditions of flooding, including rapid rise and rapid drawdown, prolonged inundation, and erosion and scour; structural fill compaction is specified or an engineering report is required, side slopes are required to be no steeper than 1:1.5.
- Specifications for slabs-on-grade are listed depending on the purpose and location of the slabs.
- Two alternatives are specified for flood openings to allow for the automatic entry and exit of floodwaters in below-BFE enclosures: nonengineered openings which do not require certification (1 sq in per sq ft of enclosed area) and engineered openings which must be certified by a registered design professional.
- Stairs and ramps shall be designed and constructed to resist flood loads and to minimize transfer of flood loads to foundations, or to break away without causing damage.
- In V Zones and Coastal A Zones:
  - Structures shall be supported on piles, columns or shear walls.
  - Foundation depth shall take into account erosion and scour.

- Specifications are provided for pile foundations, attachments to piles, different types of piles (wood, steel H, concrete-filled steel pipe, prestressed concrete, precast concrete, cast-in-place concrete).
- Specifications are provided for pile design (capacity, capacity of supporting soils, minimum penetration, spacing, pile caps, connections, splicing, and mixed and multiple types of piles).
- Specifications are provided for footings, mats, rafts, and slabs-on-grade; grade beams; bracing; and shear walls.
- Walls designed to breakaway shall not produce debris that is capable of damaging structures (breakaway walls in Coastal A Zones require openings).
- Mechanical, heating, ventilation, and air conditioning elements shall be located on the landward side of structures.
- Erosion control structures (bulkheads, seawalls, revetments) shall not be attached to buildings or focus or increase flood forces or erosion impacts on structures.
- Decks, concrete pads, and patios shall be structurally independent of buildings and constructed to break away without producing damaging debris.
- Pools shall be elevated, designed to breakaway without producing damaging debris, or sited to remain in the ground without obstructing flow that causes damage.

- Dry floodproofed nonresidential buildings and non-residential portions of mixed-use buildings are:
  - Not permitted in V Zones, Coastal A Zones, where flood velocities exceed 5 ft/sec, where conformance with certain human intervention limits cannot be achieved.
  - Required to have at least one exit door above the design flood elevation.
  - Allowed where warning time is a minimum of 12 hours unless a community warning system provides a minimum warning time sufficient to accomplish certain activities related to dry floodproofing.
  - Required to have a flood emergency plan, posted in at least two conspicuous locations, that addresses specified elements and actions.

Flood-Damage Resistant Materials

- Flood-damage resistant materials shall be used below the lowest floor elevations, including freeboard (see table below).
- Requires structural steel exposed to salt water, salt spray, or other corrosive agents to be hot-dipped galvanized after fabrication; other metal components shall be stainless steel or hot-dipped galvanized.

Utilities and Service Equipment

- Utilities and attendant equipment that is elevated shall not be located below the lowest floor elevations, including freeboard (see table below).
- Fuel supply lines shall be equipped with float operated automatic shut-off valves.

- Tanks that are below the design flood elevation and that are attached to or beneath buildings shall 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 shall be equipped with controls that prevent the cab from descending into floodwaters.

Siting Considerations

- Structures shall not be built in:
  - Areas subject to flash flooding (floodwaters rise to 3' or more above banks in less than 2 hours).
  - Erosion-prone areas (determined by analyses) unless protected.
  - High velocity flow areas (faster than 10 ft/sec) unless protected.
- Buildings in proximity to flood protective works (dams, levees, floodwalls, diversions, channels) shall not have adverse effects on, or conflict with, maintenance and repairs of those protective works.
- In-ground and above-ground pools shall be designed to withstand flood loads and load combinations; pools that are structurally connected to structures are to be designed to function as a continuation of foundations.

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See next page for description of Categories ➔		Category I	Category II	Category III	Category IV
Elevation of Lowest Floor (A Zone: Table 2-1)	All A Zones not identified as Coastal A Zones: elevation of lowest floor	DFE	BFE +1 ft or DFE, whichever is higher	BFE +1 ft or DFE, whichever is higher	BFE +2 ft or DFE, whichever is higher
Elevation of Bottom of Lowest Horizontal Structural Member (V Zone: Table 4-1)	All V Zones and Coastal A Zones: where the lowest horizontal structural member is parallel to direction of wave approach	DFE	DFE	BFE +1 ft or DFE, whichever is higher	BFE +1 ft or DFE, whichever is higher
	All V Zones and Coastal A Zones: where the lowest horizontal structural member is perpendicular to direction of wave approach	DFE	BFE +1 ft or DFE, whichever is higher	BFE +2 ft or DFE, whichever is higher	BFE +2 ft or DFE, whichever is higher
Elevation Below Which Flood-Damage-Resistant Materials Shall be Used (Table 5-1)	All A Zones not identified as Coastal A Zones	DFE	BFE +1 ft or DFE, whichever is higher	BFE +1 ft or DFE, whichever is higher	BFE +2 ft or DFE, whichever is higher
	All V Zones and Coastal A Zones: where the lowest horizontal structural member is parallel to direction of wave approach	DFE	BFE +1 ft or DFE, whichever is higher	BFE +2 ft or DFE, whichever is higher	BFE +2 ft or DFE, whichever is higher
	All V Zones and Coastal A Zones: where the lowest horizontal structural member is perpendicular to direction of wave approach	DFE	BFE +2 ft or DFE, whichever is higher	BFE +3 ft or DFE, whichever is higher	BFE +3 ft or DFE, whichever is higher
Minimum Elevation of Utilities and Equipment (Table 7-1)	All A Zones not identified as Coastal A Zones	DFE	BFE +1 ft or DFE, whichever is higher	BFE +1 ft or DFE, whichever is higher	BFE +2 ft or DFE, whichever is higher
	All V Zones and Coastal A Zones: where the lowest horizontal structural member is parallel to direction of wave approach	DFE	BFE +1 ft or DFE, whichever is higher	BFE +2 ft or DFE, whichever is higher	BFE +2 ft or DFE, whichever is higher
	All V Zones and Coastal A Zones: where the lowest horizontal structural member is perpendicular to direction of wave approach	DFE	BFE +2 ft or DFE, whichever is higher	BFE +3 ft or DFE, whichever is higher	BFE +3 ft or DFE, whichever is higher
Dry Floodproofing of non-residential structures and non-residential portions of mixed-use buildings (Table 6-1)	All A Zones not identified as Coastal A Zones: elevation to which dry floodproofing extends	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, whichever is higher
	All V Zones and Coastal A Zones: dry floodproofing not allowed	Not permitted	Not permitted	Not permitted	Not permitted

TABLE 1-1. Classification of Structures for Flood-Resistant Design and Construction (Classification same as ASCE 7, Ref. [1])

Nature of Occupancy	Category
Structures that represent a low hazard to human life in the event of failure including, but not limited to: ▪ Agricultural facilities[a] ▪ Certain temporary facilities ▪ Minor storage facilities[b]	I
All structures except those listed in Categories I, III and IV	II
Structures that represent a substantial hazard to human life in the event of failure including, but not limited to: ▪ Buildings and other structures where more than 300 people congregate in one area ▪ Buildings and other structures with day-care facilities with capacity greater than 150 ▪ Buildings and other structures with elementary school or secondary school facilities with capacity greater than 250 ▪ Buildings and other structures with a capacity greater than 500 for colleges or adult education facilities ▪ Health care facilities with a capacity of 50 or more resident patients but not having surgery or emergency treatment facilities ▪ Jails and detention facilities ▪ Power generating stations and other public utility facilities not included in Category IV Buildings and other structures not included in Category IV (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 sufficient quantities of hazardous materials considered to be dangerous to the public if released. Buildings and other structures containing hazardous materials shall be eligible for classification as Category II structures if it can be demonstrated to the satisfaction of the authority having jurisdiction by a hazard assessment as described in Section 1.5.2[c] that a release of the hazardous material does not pose a threat to the public.	III
Structures designated as essential facilities including but not limited to ▪ Hospitals and other health-care facilities having surgery or emergency treatment facilities ▪ Fire, rescue, ambulance, and police stations and emergency vehicle garages ▪ Designated earthquake, hurricane, or other 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 an emergency ▪ Ancillary structures (including, but not limited to, communication towers, fuel storage tanks, cooling towers, electrical substation structures, fire water storage tanks or other structures housing or supporting water, or other fire-suppression material or equipment) required for operation of Category IV structures during an emergency ▪ Aviation control towers, air traffic control centers, and emergency aircraft hangars ▪ Water storage facilities and pump structures required to maintain water pressure for fire suppression ▪ Buildings and other structures having critical national defense functions 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, hazardous waste, or explosives) containing extremely hazardous materials where the quantity of the material exceeds a threshold quantity established by the authority having jurisdiction. Buildings and other structures containing extremely hazardous materials shall be eligible for classification as Category II structures if it can be demonstrated to the satisfaction of the authority having jurisdiction by a hazard assessment as described in Section 1.5.2[c] that the extremely hazardous material does not pose a threat to the public. This reduced classification shall not be permitted if the buildings or structures also function as essential facilities	IV

[a]Certain agricultural structures may be exempt from some of the provisions of this Standard – see section C..4.3.
[b]For the purposes of this standard, minor storage facilities do not include commercial storage facilities.
[c]Section 1.5.2 reference is made to ASCE Standard 7-05, not this standard.