Investigating Regulatory Requirements

States and communities enforce regulatory requirements that determine where and how buildings may be sited, designed, and constructed. These requirements include those associated with programs established by federal and state statutes, building codes and standards, and locally adopted floodplain management and land use ordinances and laws.

NOTE

Unless otherwise noted, citations for the I-Codes in this guide refer to the 2006 editions.

This chapter begins with a discussion of the NFIP. The remaining sections explain how to meet the minimum requirements through enforcement of the 2006 editions of the IBC and IRC, standards ASCE 7-05 and 24-05, and other regulatory documents. The chapter outlines minimum flood- and wind-design requirements for hazard-resistant construction. Later chapters detail these requirements and provide examples of best practices to meet or exceed these requirements.

3.1 Floodplain Management Requirements and Building Codes

The NFIP is the basis for the minimum requirements included in model building codes and standards for flood-resistant design and construction methods used to withstand flood damage. FEMA manages the NFIP, which is intended to reduce the loss of life and damage caused by floods and flood-related hazards. The original authorizing legislation for the NFIP is the National Flood Insurance Act of 1968 (42 U.S.C. 4001 et seq.). In that act, the U.S. Congress expressly found that "a program of flood insurance can promote the public interest by encouraging sound land use by minimizing exposure of property to flood losses...."

NOTE

This guide does not cover manufactured housing. For NFIP requirements concerning manufactured housing, see § 60.3 of the regulations, and FEMA 85, *Manufactured Home Installation in Flood Hazard Areas*. Other relevant reference materials include NFPA 225, *Model Manufactured Home Installation Standard*, 2005 Edition and publications produced by U.S. Department of Housing and Urban Development.

The most convincing evidence of the effectiveness of the NFIP minimum requirements is found in flood insurance claim payment statistics. Buildings that pre-date the NFIP requirements were generally not constructed to resist flood damage and buildings that post-date the NFIP are designed to resist flood damage. The NFIP aggregate loss data indicates that buildings meeting the minimum requirements experience 80-percent less flood damage than buildings that pre-date the NFIP. Ample evidence suggests that buildings designed to exceed the minimum requirements are even less likely to sustain damage.

3.1.1 Overview of the National Flood Insurance Program

The NFIP is based upon the premise that the Federal government will make flood insurance available in communities that adopt and enforce floodplain management regulations that meet or exceed the minimum NFIP requirements. When decisions result in development within flood hazard areas, application of the criteria of the NFIP are intended to minimize exposure and flood-related damage. State and local governments are responsible for applying the provisions of the NFIP through the regulatory permitting processes. At the Federal level, the NFIP is managed by FEMA and has three main functions:

- Requires communities to adopt floodplain management regulations to minimize flood damages to new buildings and those buildings that undergo substantial improvements or that have been substantially damaged.

- Provides floodplain management criteria for development, which establish the minimum requirements to be applied to development within mapped flood hazard areas. The intent is to recognize hazards in the entire land development process.

- Offers flood insurance, which provides some financial protection for property owners to cover costs associated with flood-related damage to buildings and contents.

The NFIP provisions guide development to lower-risk areas by requiring compliance with performance measures to minimize exposure of new buildings and buildings that undergo major renovation or expansion (called "substantial improvement" or repair of "substantial damage"). This achieves the long-term objective of building disaster-resistant communities.

Substantial Improvement. Any repair, reconstruction, rehabilitation, addition, or 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 improvements regardless of the actual repair work performed. The term does not, however, include either:

- 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.

- Any alteration of a historic structure, provided that the alteration will not preclude the structure's continued designation as a historic structure.

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.

3.1.2 Summary of the NFIP Minimum Requirements

Performance requirements of the NFIP are set forth in Federal Regulation 44, Code of Federal Regulations (CFR), Part 60. The requirements apply to all types of development, which the NFIP broadly defines to include buildings and structures, site work, roads and bridges, and other related activities. Residential buildings must be designed and constructed to resist flood damage, and that resistance is primarily achieved through elevation. Additional specific requirements apply to existing developments—especially existing buildings. Existing buildings that are proposed for substantial improvement, including restoration following substantial damage, are subject to the regulations.

NOTE

Communities participating in the NFIP are encouraged to adopt and enforce floodplain management ordinances or laws that include requirements more stringent than the minimum requirements of NFIP regulations. For example, approximately 60 percent of NFIP participating communities require that buildings be elevated above, rather than simply to, the BFE. The additional elevation required is referred to as freeboard. (See note box on page 2-15 and Section 4.3). See Chapter 6 for the application of freeboard into foundation design.

Although NFIP regulations focus primarily on how to build structures, one of the long-term objectives of the program is to guide development to less hazardous locations. Preparing flood hazard maps and making the information available to the public is a fundamental step in satisfying that objective. With that information, interested parties can make informed decisions about where to build, how to use site design to minimize exposure to flooding, and how to design buildings that will resist flood damage.

Community floodplain management ordinances and laws must include requirements concerning the following types of buildings in the SFHA, including those in both A Zones and V Zones: newly constructed buildings, substantially damaged buildings, and substantially improved buildings. Additional requirements must apply to new subdivisions and other development within the SFHA.

Recognizing the greater hazard posed by breaking waves of 3 feet high or higher, FEMA has established the following minimum NFIP regulatory requirements for newly constructed, substantially damaged, and substantially improved buildings located in a V Zone. These requirements are more stringent than the minimum requirements for A Zone buildings:

- Only open-foundation types are allowed.
- The structure or building must be elevated such that the lowest horizontal structural member is constructed at or above the BFE.
- Buildings must be designed and constructed to resist simultaneous wind and flood loads.
- Building designs must be certified by an engineer.

NOTE

"Reasonably safe from flooding" is defined as a situation in which base flood waters will not inundate the land or damage existing or proposed structures. This would include any subsurface waters related to the base flood.

The location of a building in relation to the A Zone/V Zone boundary on a FIRM can affect the building design. A building or other structure that has any portion of its foundation in a V Zone must be built to comply with V Zone requirements. For best practices, these V Zone requirements should be considered for adoption within Coastal A Zones in order to improve building performance. The subsections below summarize the minimum NFIP regulatory requirements and provide detailed information on V, A, and Coastal A Zone requirements.

NOTE

In addition to the floodplain management requirements discussed in this guide, NFIP regulations include requirements specific to floodplains along rivers and streams. Because this guide focuses on the construction of residential buildings in coastal areas, it does not provide significant detail on these additional requirements. For more information about these requirements, see FEMA 259, *Engineering Principles and Practices for Retrofitting Floodprone Buildings*, 2001 Edition.

3.1.3 Minimum Requirements for All Buildings in All SFHAs

The minimum floodplain management requirements apply to all SFHAs located in communities participating in the NFIP. The requirements affect buildings, subdivisions, and other new development; new and replacement water supply systems; and new and replacement sanitary sewage systems. Below is a summary of some important aspects of 44 CFR Part 60.3, as presented in the Code:

Site Design

The NFIP's broad performance requirements for site work in flood hazard areas are shown below.

- Building sites shall be reasonably safe from flooding.
- Adequate site drainage shall be provided to reduce exposure to flooding.
- New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of floodwaters into the systems, as well as discharges from the systems into floodwaters.
- Development in floodways shall be prohibited, unless engineering analyses show that there will be no increases in flood levels.

General Performance Requirements

The NFIP's broad performance requirements for new buildings proposed for flood hazard areas and the substantial improvement of existing floodprone buildings are listed below:

- Buildings shall be designed and adequately anchored to prevent flotation, collapse, or lateral movement resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy.
- Building materials used below the design flood elevation shall be resistant to flood damage.
- Buildings shall be constructed by methods and practices that minimize flood damage primarily by elevating to or above the BFE, or by specially designed and certified floodproofing measures.

- Buildings shall be constructed with electrical, heating, ventilation, plumbing, and air conditioning equipment and other service facilities that are designed and/or located so as to prevent water from entering or accumulating within the components.

- If FEMA has not provided BFE data on the FIRM, the community must obtain, review, and reasonably utilize any BFE data available from a Federal, a State, or other sources for the purpose of regulating construction in SFHAs.

Subdivisions and Other New Development in the SFHA

- All proposals for subdivisions and other new developments greater than 50 lots or 5 acres (whichever is less) in an SFHA for which no BFEs are shown on the effective FIRM must be accompanied by 100-year flood elevation data.

- All proposals for subdivisions and other new development in the SFHA must be consistent with the need to minimize flood damage within the floodprone area.

- All public utilities and facilities (such as sewer, gas, electrical, and water systems for such subdivisions and other new developments) must be located and constructed to minimize or eliminate flood damage.

NOTE

For more information about opening requirements for the walls of enclosures below the lowest floors of buildings in A Zones, see FEMA NFIP Technical Bulletin 1: *Openings in Foundation Walls and Walls of Enclosures*.

- Adequate drainage must be provided for all such subdivisions and new developments in order to reduce exposure to flood hazards.

New and Replacement Water Supply Systems in the SFHA

- New and replacement water supply systems within the SFHA must be designed to minimize or eliminate infiltration of floodwaters.

New and Replacement Sanitary Sewage Systems in the SFHA

- New and replacement sanitary sewage systems in the SFHA must be designed to minimize or eliminate infiltration of floodwaters into the systems and discharges from the systems into floodwaters.

- Onsite waste disposal systems must be located to avoid impairment to them or contamination from them during flooding.

3.1.3.1 Minimum Requirements for Buildings in V Zones

The minimum requirements enforced by participating communities regarding newly constructed buildings, substantially damaged buildings, and substantially improved buildings in zones VE, V1–V30, and V pertain to the siting of the building, the elevation of the lowest floor in relation to the BFE, the foundation design, enclosures below the BFE, and alterations of sand dunes and mangrove stands (see 44 CFR Part 60.3(d)).

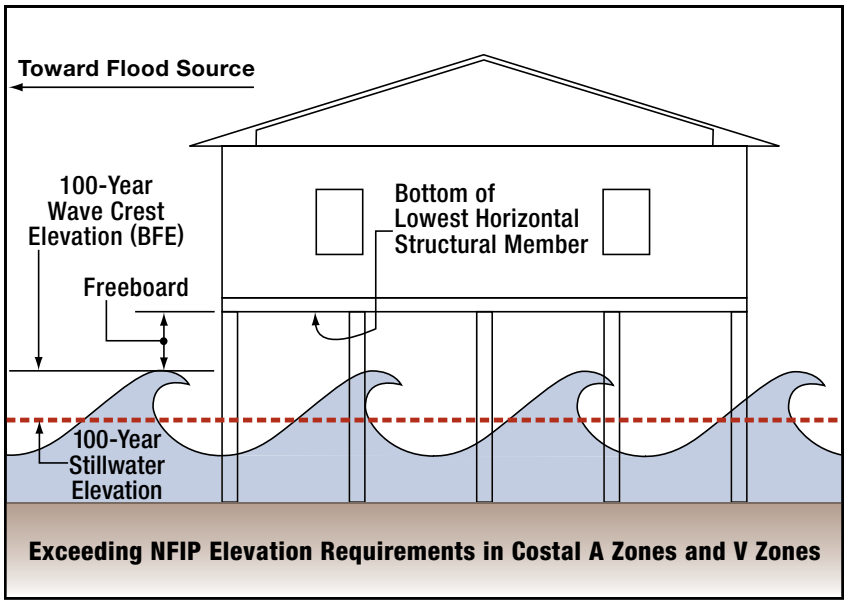

Figure 3-1.
MINIMUM NFIP V ZONE REQUIREMENTS: In V Zones, buildings must be elevated on an open foundation (e.g., pilings, posts, piers, or columns) so that the bottom of the lowest horizontal structural member is located at or above the BFE. (Source: FEMA 55)

Siting

All newly constructed buildings must be located landward of the reach of mean high tide (i.e., the mean high water line). In addition, human-caused alterations of sand dunes or mangrove stands are prohibited if those alterations would increase potential flood damage. Removing sand or vegetation from (or otherwise altering) a sand dune or removing mangroves may increase the potential of flood damage. Therefore, such actions must not be carried out without the prior approval of a local official.

Building Elevation

All newly constructed, substantially damaged, and substantially improved buildings must be elevated on open foundations using pilings, posts, piers, or columns so that the bottom of the lowest horizontal structural member of the lowest floor (excluding the vertical foundation members) is at or above the BFE (see Figure 3-1).

Foundation Design

The foundations for all newly constructed, substantially damaged, and substantially improved buildings (as well as the buildings attached to the foundations), must be anchored to resist flotation, collapse, and lateral movement due to the effects of wind and water loads acting simultaneously on all building components. A registered engineer or architect must develop or review the structural design, construction specifications, and plans for construction and must certify that the design and methods of construction to be used are in accordance with accepted standards of practice for meeting the building elevation and foundation design standards described above. In addition, erosion control structures and other structures (such as bulkheads, seawalls, and retaining walls) may not be attached to the building or its foundation.

Fill may not be used for the structural support of any building within zones VE, V1–V30, and V. Fill may be used in V Zones for minor landscaping and site drainage purposes provided that the fill does not interfere with the free passage of floodwaters and debris underneath the building or cause damages in the flow direction during coastal storms such that floodwaters will cause additional damages to buildings on the site or to any adjacent buildings.

Space Below the BFE

The space below all newly constructed, substantially damaged, and substantially improved buildings must either be free of obstructions or enclosed only by non-supporting breakaway walls, open latticework, or insect screening intended to collapse under water loads without causing collapse, displacement, or other structural damage to the elevated portion of the building or the supporting foundation system. Further, specific NFIP requirements are in place regarding permitted uses below the BFE and the use of flood-damage-resistant materials below the BFE. The enclosed area below the BFE can be used for parking, building access, or storage purposes, and any mechanical or utility equipment must remain protected or be elevated to the BFE.

NOTE

Although NFIP regulations permit below-BFE enclosures that meet the criteria presented here, many communities may have adopted ordinances that prohibit all such enclosures or that establish more stringent criteria, such as an enclosure size limitation.

Current NFIP regulatory requirements for breakaway walls are set forth at 44 CFR Part 60.3(e)(5). The regulations specify a design safe-loading resistance for breakaway walls of not less than 10 lb/ft^2 and not more than 20 lb/ft^2. Regulations also provide for the use of alternative designs that do not meet the specified loading requirements. Generally, the use of breakaway walls built according to such designs is permitted if a registered professional engineer or architect certifies that the walls will collapse under a water load less than that which would occur during the base flood and that the elevated portion of the building and supporting foundation system will not be subject to collapse, displacement, or other structural damage due to the effects of wind and water loads acting simultaneously on all building components.

NOTE

For more information about enclosures, the use of space below elevated buildings, and breakaway walls, see FEMA 499, *Home Builder's Guide to Coastal Construction Technical Fact Sheet Series.*

Research conducted for FEMA and the National Science Foundation by North Carolina State University (NCSU) and Oregon State University (OSU)—including full-scale tests of breakaway wall panels—provides the basis for prescriptive criteria related to the design and construction of alternative-type breakaway wall panels that do not meet the requirement for a loading resistance of 10–20 lb/ft^2. These criteria are presented in the 2008 FEMA NFIP Technical Bulletin 9: *Design and Construction Guidance for Breakaway Walls Below Elevated Coastal Buildings* (FIA-TB-9). The criteria address breakaway wall construction materials (including wood framing, light-gauge steel framing, and masonry); attachment of the walls to floors and foundation members; utility lines; wall coverings (such as interior and exterior sheathing, siding, and stucco); and other design and construction issues. The bulletin also describes the results of the NCSU/OSU tests, which are described in greater detail in *Behavior or Breakaway Walls Subjected to Wave Forces: Analytical and Experimental Studies* (Tung et al., 1999).

3.1.3.2 Minimum Requirements for Buildings in A Zones

In addition to the general requirements stated above, the following minimum requirements are specific to buildings and structures located in zones AE, A1–A30, AO, and A. The discussion below addresses how each of the requirements is defined according to the flood zone.

- The elevation of the top of the lowest floor (i.e., Finished Floor Elevation (FFE)), including finished basements, in relation to the BFE or the depth of the 100-year-flood event (FFE must be at or above BFE).

- Enclosed areas below the lowest floor. (Note that these requirements are the same for coastal and non-coastal A Zones.)

Building Elevation in Zones AE and A1-A30

The top of the lowest floor (including the basement floor) of all newly constructed, substantially damaged, and substantially improved buildings must be positioned at or above the BFE (see Figure 3-2). If a closed foundation is used, flood openings must be present to account for hydrostatic pressure.

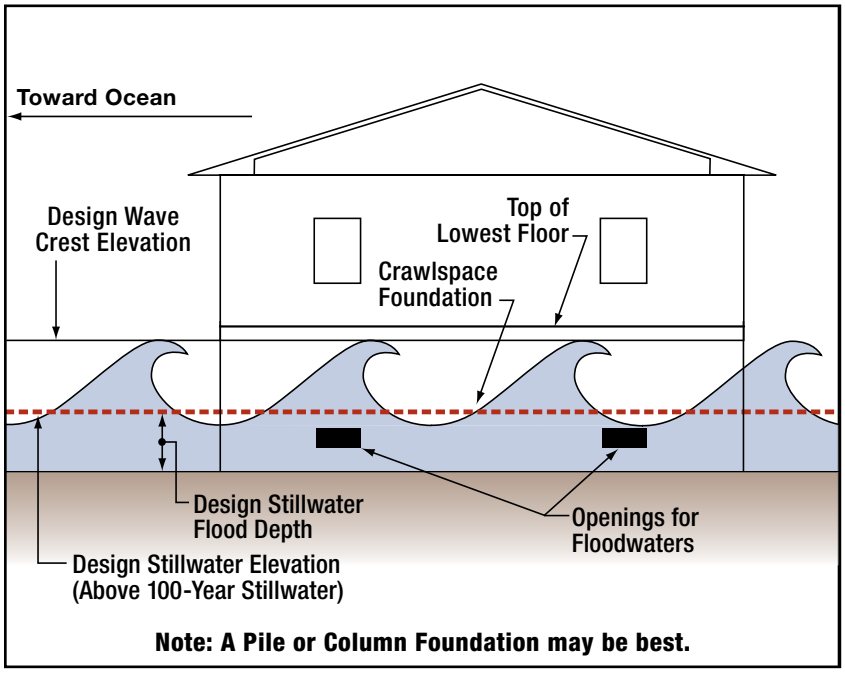

Figure 3-2. MINIMUM NFIP A ZONE REQUIREMENTS: The lowest floors of buildings in zones AE, A1–A30, and A must be positioned at or above the BFE. Foundation walls below the BFE must be equipped with openings that allow the automatic entry of floodwaters so that interior and exterior hydrostatic pressures can equalize. (Source: FEMA 55)

Building Elevation in Zone A

FIRMs do not present BFEs in SFHAs designated as Zone A (i.e., unnumbered A Zones). The lowest floors of buildings in Zone A must be elevated to or above the BFE whenever BFE data is available from other sources. If no BFE data is available, communities must ensure that the building is constructed with methods and practices that minimize flood damage. If a closed foundation is used, flood openings must be present in the foundation walls in order to account for hydrostatic pressure.

Building Elevation in Zone AO

Zone AO designates areas where flooding is characterized by shallow depths (averaging 1 to 3 feet) and/or unpredictable flow paths. In Zone AO, the top of the lowest floor (including the basement floor) of all newly constructed, substantially damaged, and substantially improved buildings must be above the highest grade adjacent to the building by at least the depth of flooding in feet shown on the FIRM. For example, if the flood depth shown on the FIRM is 3 feet, the top of the lowest floor must be positioned at least 3 feet above the highest grade adjacent to the building. If no depth is shown on the FIRM, the minimum required height above the highest adjacent grade is 2 feet. If a closed foundation is used, flood openings must be present in the foundation walls to account for hydrostatic pressure.

Note that areas adjacent to V Zones (such as behind bulkheads or on the back sides of dunes) are sometimes designated as Zone AO. For such areas, this guide encourages the use of open foundations—as required in V Zones (see Subsection 3.2.4.3 of this guide)—for Zone AO.

Enclosures Below the Lowest Floor in Zones AE, A1–A30, AO, and A

Enclosed space below the lowest floors of newly constructed, substantially damaged, and substantially improved buildings may be used only for vehicle parking, building access, or storage purposes. The walls of such areas must be equipped with openings designed to allow the automatic entry and exit of floodwaters so that interior and exterior hydrostatic pressures will equalize during flooding. Designs for openings must either meet or exceed the following minimum criteria:

1. A minimum of two openings with a total net area of not less than 1 square inch for every 1 square foot of enclosed area subject to flooding must be provided.

2. The bottoms of all openings must be no higher than 1 foot above grade.

3. The openings may be equipped with screens, louvers, valves, or other coverings or devices–provided that they permit the automatic entry and exit of floodwaters.

An alternative to meeting Criterion 1 above is to provide a certification by a registered engineer or architect that states that the openings are designed to automatically equalize hydrostatic forces on exterior walls by allowing the entry and exit of floodwaters. Even if such a certification is provided, however, the openings must still meet criteria 2 and 3.

3.1.3.3 Recommendations for Coastal A Zones and V Zones

The NFIP regulations currently do not differentiate between coastal and non-coastal A Zones. Because Coastal A Zones may be subject to the types of hazards present in V Zones (such as wave effects, velocity flows, erosion, scour, and high winds), this guide recommends that buildings in Coastal A Zones meet the NFIP regulatory requirements for V Zone buildings (i.e., the performance requirements concerning resistance to flotation, collapse, and lateral movement, as well as the prescriptive requirements for elevation, foundation type, engineering certification of design and construction, enclosures below the BFE, and the use of structural fill).

To provide a greater level of protection against the hazards typical to Coastal A Zones and V Zones, this guide recommends the following guidance as good practice for the siting, design, and construction of buildings within those zones:

NOTE

The term "Coastal A" refers to the area within the A Zone where breaking waves are between 3 feet and 1.5 feet high. These areas are not specifically delineated on FIRMs.

- The building should be located landward of both the long-term erosion setback and the limit of 100-year flood event erosion, rather than simply landward of the reach of mean high tide.
- The bottom of the lowest horizontal structural member should be elevated above–rather than to–the BFE (i.e., freeboard should be provided; see Figure 3-3).
- Open latticework or screening should be used in lieu of breakaway walls in the space below the elevated building or, at a minimum, the use of solid breakaway wall construction should be minimized.
- In V Zones, the lowest horizontal structural members should be oriented perpendicularly to the expected wave crest.

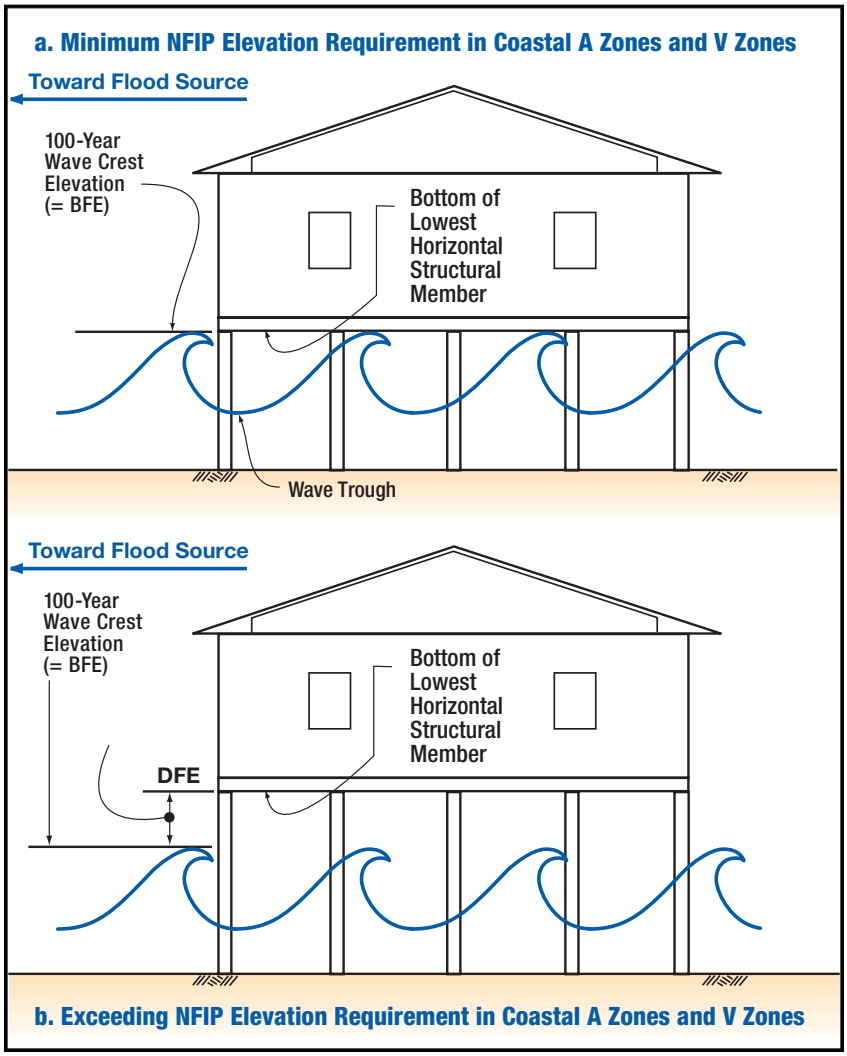

Figure 3-3. RECOMMENDED ELEVATION FOR BUILDINGS IN COASTAL A ZONES AND V ZONES: The bottom of the lowest horizontal structural member must be positioned above the BFE (rather than elevated to the BFE, as shown in Figure 3-1). The additional amount of elevation above the BFE is referred to as "freeboard." In V Zones, the lowest horizontal structural members should be perpendicular to the expected wave crest. (Source: FEMA 55)

3.2 Building Codes and Standards

> **NOTE**
>
> Applicable climatic and geographic design criteria are found in IRC Table 301.2(1).

The purpose of a building code is to establish the minimum acceptable design and construction requirements necessary for protecting the public health, safety, and welfare within the built environment. All building codes and standards are developed through a public consensus process. Building codes apply primarily to new construction, but may also apply to existing buildings that are being rebuilt, retrofitted, or renovated. Codes may also apply when a building is undergoing a change in use, as defined by the code. The building code specifies the applicable climatic and geographic design criteria (including rain and snow loads, wind speed, seismic design category, frost depth, termite susceptibility, flood hazards, air freezing index, and mean annual temperature).

> **NOTE**
>
> ASCE 7-05 outlines methods to determine design loads and load combinations in flood hazard areas (including hydrostatic loads, hydrodynamic loads, wave loads, and debris impact loads). To compute the loads and load combinations, the designer must identify site-specific characteristics (including flood depths, velocities, waves, and the likelihood that debris impacts need to be considered).
>
> ASCE 24-05 addresses design requirements for buildings in Coastal High Hazard Areas.

The most widely adopted model codes are developed by the International Code Council (http://www.iccsafe.org). As of mid 2008, there has been at least one community in all 50 states that has adopted at least one or more of the I-Codes (including the IBC, IRC, International Existing Building Code, and a series of codes for mechanical, plumbing, fuel gas, and onsite sewage installations). This guide references the 2006 editions of the IBC and IRC along with ASCE 7-05 and ASCE 24-05 as though they have been adopted in every jurisdiction. If these codes have not been adopted in the reader's jurisdiction without modification (such as with an "IBC-based" code or with local/state amendments), the requirements set forth here may be considered guidance.

During the development of the I-Codes, FEMA was consulted to ensure that the direction given in the codes remains consistent with the minimum requirements of the NFIP. Since 2000, the I-Codes have included provisions for buildings in flood hazard areas, and the 2003 and 2006 editions have been deemed by FEMA to be consistent with the NFIP.

The IBC is a performance code that generally requires buildings and structures to be individually designed to meet the requirements of the code and various referenced standards. Two important standards referenced–(1) ASCE 7-05 outlining loading criteria for wind, flood, and environmental loads and (2) ASCE 24-05–include provisions pertaining to flood hazards. These standards are briefly described in Sections 3.2.2.1 through 3.2.3.

The IRC addresses relevant design criteria (loads) in a more prescriptive approach so that some one- and two-family homes can be built without individual designs prepared by architects and engineers (with the exception of homes in A and V Zones). Homes may be designed and constructed to the IRC criteria, but generally a prescriptive approach to design is used for inland construction. Due to the IRC not being prescriptive about flood design, coastal construction requirements typically lead to individual designs of residential structures.

Although not specifically covered in this guide, one other notable building code adopted in some jurisdictions is NFPA 5000, *Building Construction and Safety Code*, developed by the National Fire Protection Association. This code includes provisions for buildings in flood hazard areas. The NFPA also develops standards, including NFPA 225, *Model Manufactured Home Installation Standard*, the first such standard to include provisions for manufactured home installation within flood hazard areas. This standard provides some guidance on appropriate measures required for manufactured homes.

3.2.1 Flood and Wind Requirements in the IBC and IRC

NOTE

A crosswalk of the NFIP regulations and the IBC and IRC provisions is found in the publication *Reducing Flood Losses through the International Code Series: Meeting the Requirements of the NFIP* (published by the ICC) and in Table 3-1, which is located at the end of this chapter.

The IBC addresses flood loads and flood-resistant construction primarily in Section 1612 (Flood Loads), which refers to the consensus standards ASCE 7-05 (in Chapter 5) and ASCE 24-05. Similarly, wind loads and wind-resistant construction are addressed in Section 1609 (Wind Loads) of the IBC. The IBC states that wind loads should be calculated as indicated in Chapter 6 of ASCE 7-05. The code then defines prescriptive methods for designing openings, louvers, and roof systems. Flood loads, wind loads, and load combinations are specified in Section 1605. The designer must identify the pertinent, site-specific characteristics and then use ASCE 7-05 to determine the specific loads and load combinations. The IBC, in effect, is similar to a local floodplain ordinance that requires determination of the environmental conditions (e.g., mapped flood hazard area, BFE/depth of water) and then specifies certain conditions that must be met during design and construction. The body of the IBC (together with Appendix G, if specifically adopted by the AHJ) addresses all of the key building and development requirements of the NFIP. If the AHJ chooses not to adopt the I-Code, the applicable code should comply with minimum NFIP requirements.

NOTE

Design Flood Elevation (DFE) – At a minimum, the Base Flood Elevation (i.e., elevation of the 100-year flood event). However, the DFE could be higher due to freeboard or additional elevation mandated by the authority having jurisdiction.

The IRC is a prescriptive code that generally provides a prescriptive design approach that simplifies the design process and, as a result, does not always lead to individual designs for residential buildings. The IBC can be used if the building does not meet the guidance developed for the IRC. However, to ensure consistency with the NFIP in coastal high-hazard areas (V Zones), the IRC requires submission of documentation by a registered design professional stating that the design and methods of construction to be used meet applicable requirements. The IRC applies to one- and two-family dwellings and to some townhouses. In NFIP terminology, the IRC is used for residential structures.

The IRC addresses flood-resistant construction primarily in Section R324 (Flood-Resistant Construction, renumbered from R323 in previous versions), although provisions for mechanical and plumbing installations are included in pertinent sections of the code. Section R301 (Design Criteria) of the IRC addresses the limitations of the prescriptive aspects of the code based upon basic wind speed requirements and stipulates that if the wind speed requirements exceed those in the prescriptive guidance, the structure should be designed in accordance with one of five codes or standards (see the list on the following page). Section R301.2.1.1 should be consulted to verify that the applicable/supplemental code or design guidance is being used.

- American Forest & Paper Association, *Wood Frame Construction Manual for One- and Two-Family Dwellings* (WFCM)
- Southern Building Code Congress International, *Standard for Hurricane-Resistant Residential Construction* (SSTD 10)
- ASCE/SEI 7-05, *Minimum Design Loads for Buildings and Other Structures*
- American Iron and Steel Institute, *Standard for Cold-Formed Steel Framing: Prescriptive Method for One- and Two-Family Dwellings* (COFS/PM) with supplement to Standard for Cold-Formed Steel Framing–Prescriptive Method for One- and Two-Family Dwellings
- Concrete construction shall be designed in accordance with the provisions of the IRC.

The IRC does not specifically refer to ASCE 7-05 or ASCE 24-05 for flood loads. However, Section R324.3.6 does require a registered design professional to prepare and seal the construction documents, thus requiring the design professional to use ASCE 7-05 and ASCE 24-05 when designing flood-resistant structures.

3.2.1.1 Minimum Flood Requirements of the Building Codes

Buildings constructed in A and V Zones must comply with specific provisions of the IBC or the IRC, if they are adopted. The summary below is an overview of the most significant requirements, but it is not a complete listing of the codes and should not be relied upon for ensuring full compliance with either the IBC or the IRC. The requirements within the codes should be evaluated during the plan review process before issuance of the building permit. The permit process is discussed in detail in Chapter 4.

NOTE

In the terminology of the NFIP, the International Building Code is used for non-residential structures. Note, however, that the IBC does apply to some types of residential structures, such as multi-family dwellings.

The requirements outlined in IRC Section R324 are summarized below:

1. All structural systems must be designed to resist flotation, collapse, or permanent lateral movement due to loads and stresses from flooding.
2. All structures prone to flooding shall be designed to minimize flooding.

NOTE

The 2009 IRC will require 1 foot of freeboard in V Zones and Coastal A Zones.

3. All structures shall be elevated for compliance with the DFE, as established by locally adopted ordinances and shall be at (at a minimum) the 100-year flood elevation. A licensed architect, engineer, or land surveyor must determine and confirm that the floor level conforms to that particular community's DFE. All floor levels must be established at or above the BFEs indicated on the FIRM.
4. All mechanical and electrical equipment and components shall be elevated to the minimum DFE.

5. All new and existing water supply and sanitary systems shall be designed to eliminate or minimize the infiltration of floodwater into the system.

6. All wood used below the DFEs shall be pressure-preservative-treated or be decay-resistant.

7. In V Zones (or Coastal A by local adoption), all enclosed areas below the DFE shall be used solely for the parking of vehicles, building access, and storage. In addition, the enclosures shall be made compliant with the provisions of the code to allow floodwater movement.

8. All foundations shall be designed to comply with all provisions of the codes.

3.2.1.2 Minimum Wind Requirements of the Building Code

Building safety depends upon more than the adopted codes and the standards that they reference. While building-code effectiveness depends partly on the presence of an effective building department within that community, true building safety is most likely achieved when buildings are properly designed by trained professionals, who have the resources and ongoing support they need to stay apprised of advancements in building safety.

An effective building safety system provides uniform interpretations of the code, product evaluations, and professional development and certification for inspectors and plan reviewers. Local building departments play a key role in ensuring that buildings are designed and constructed in accordance with applicable building codes.

Building codes, however, are not all-inclusive. Omissions or conflicts with other rules, ordinances, or legislation may exist. General limitations to wind provisions in the building codes include the following:

- Because codes are adopted and enforced at the local or state level, the authority having jurisdiction has the power to eliminate or modify wind-related provisions of a model code, or to write its own code instead. In jurisdictions for which wind-related provisions of the current model code are not adopted and enforced, buildings and critical facilities are more susceptible to wind damage. In addition, a time lag may exist between the time a model code is updated and the time it is implemented by a jurisdiction. Buildings designed to the minimum requirements of an outdated code are, therefore, not taking advantage of the latest industry knowledge. These buildings are prone to poorer wind performance, as compared to buildings designed according to current model codes.

- Adopting the current model code alone does not ensure good wind performance. To achieve good wind performance (in addition to good design), the construction of the building itself must be effectively executed and the building must be adequately maintained and repaired.

The 2006 editions of the IBC and IRC are regarded as effective codes, when they are carefully followed and their rules properly enforced. Neither the 2006 editions of the IBC or the IRC account for the wind loads exerted by tornadoes. These loads are generally considered to be too excessive for practical design of entire buildings. The codes focus on creating structures that will sustain minimal damage when exposed to the design hazard. The codes are designed to protect structures; however, it is important to note that the codes are not intended to create storm shelters. (Occupants should seek refuge in an appropriate shelter or FEMA safe room in the event of a storm.)

The 2000, 2003, and 2006 editions of the IBC rely on several referenced standards and test methods developed or updated during the 1990s. Prior to adoption, most of these standards and test methods had not been validated by actual building performance during design-level wind events. The hurricanes of 2004 and 2005 provided an opportunity to evaluate the actual performance of buildings designed and constructed to the minimum provisions of the IBC. Building performance evaluations conducted by FEMA revealed the need for further enhancements. A limitation of the 2006 editions of the IBC and IRC involves some of the test methods used to assess wind and the wind-driven rain resistance of building-envelope components. However, before this code limitation can be overcome, research must be conducted and new test methods developed.

These limitations should not be seen as inadequacies in the codes, but rather as issues about which building officials should remain aware. Overwhelming evidence suggests that structures built to IBC and IRC standards perform significantly better during storm events than buildings not constructed to code. In many cases, structures built to IBC and IRC standards were the only ones to survive storm loads in impacted areas.

3.2.1.3 Evolution of Wind Requirements in the Building Codes and Standards

Recognition of increased uplift loads at the roof perimeter and corners. Prior to the 1982 editions of the Standard Building Code and the Uniform Building Code, and the 1987 edition of the National Building Code, these model codes did not account for the increased uplift at the roof perimeter and corners. Therefore, buildings designed in accordance with earlier editions of these codes are very susceptible to the loss of the roof covering and/or roof decking during high-wind events.

NOTE

ASCE 7-05 requires the protection of glazed openings in windborne debris areas within hurricane-prone regions. Glazing protection can be an impact-resistant glazing protection (such as laminated glass or polycarbonate) or shutters or screens tested in accordance with ASTM standards specified in ASCE 7-05. The windborne debris-protection criteria were developed to minimize property damage and to improve building performance. (The criteria were not developed for occupant protection.)

Adoption of ASCE 7 for design wind loads: Although the Standard Building Code, the Uniform Building Code, and the National Building Code permitted the use of ASCE 7, the 2000 edition of the IBC was the first model code to require ASCE 7 for determining wind design loads. The IRC also recommends the use of ASCE 7 for wind design or other methods, but provides alternative tables for prescriptive design pressures for qualified buildings.

Roof coverings: Several performance and prescriptive requirements pertaining to the wind resistance of roof coverings have been incorporated into the model codes. Poor performance of roof coverings was widespread during hurricanes Hugo (1989) and Andrew (1992). Prior to the 1991 editions of the Standard Building Code and the Uniform Building Code, and the 1990 edition of the National Building Code, these model codes did not directly address roof covering wind loads and test methods for determining uplift resistance. Most of these additional provisions were added following Hurricane Andrew. Following these storms, Building Performance Assessment Teams (BPAT) were dispatched to evaluate construction techniques used on various buildings and gather information based upon the damages. These BPATs (now called Mitigation Assessment Teams [MAT]) were comprised of technical experts from FEMA, code experts, and consultants from public and private entities. The BPATs and MATs have made recommendations on improving building performance and influenced future codes in this and other areas of study. Changes to the building codes based upon these recommendations continue to be made through

the 2006 edition of the IBC (such as, Section 1504.8 which added a provision prohibiting aggregate roof surfaces in hurricane-prone regions) and also future editions which are currently in the consensus development process.

Glazing protection: The 2000 edition of the IBC was the first model code to address windborne debris requirements for glazing in buildings located in hurricane-prone regions (via reference to the 1998 edition of ASCE 7). The 1995 edition of ASCE 7 was the first edition of that standard to address windborne debris requirements.

Parapets and rooftop equipment: The 2003 edition of the IBC was the first model code to address wind loads on parapets and rooftop equipment (via reference to the 2002 edition of ASCE 7, which was the first edition of ASCE 7 to address these elements).

3.2.2 ASCE 7 Requirements

The ASCE develops and maintains the consensus standard for load determination on buildings and structures: ASCE 7-05. This standard specifies the loads and load combinations to be used in design and is incorporated by references in the 2006 editions of both the IBC and the IRC. This standard is the basis for loadings used in many of the prescriptive methods outlined in the IRC. The design loads for new or modified construction consider permanent and temporary loads (such as snow and rain loading), as well as loads from other more significant natural hazards (such as seismic events, high wind, and flood loads).

For this guide, flood- and wind-load requirements are discussed because they are the most significant load conditions within coastal areas. The commentary sections of ASCE 7 provide detailed discussions of these and other loads.

3.2.2.1 Flood Requirements

Coastal areas experience several flood loads that can occur simultaneously. Storm surge, debris impact, erosion, and scour can contribute to loads exerted on a building. The following sections of ASCE 7 address flood loads:

- Section 2: Combinations of Loads, including different load combinations for V Zones and Coastal A Zones.

- Section 5: Flood Loads, which covers hydrostatic, hydrodynamic, wave, and impact loads. Load criteria for breakaway walls are included.

In recognition of the growing awareness that waves with heights between 1.5 feet and 3 feet high (the cutoff used to delineate FEMA's V Zone) can cause considerable damage, ASCE 7-05 incorporates the concept of the Coastal A Zone and specifies that designers must determine breaking wave loads on structures within these areas.

3.2.2.2 Wind Requirements

Because of their geographic location, many coastal communities are susceptible to high-wind events, such as hurricanes, tornadoes, and nor'easters. The wind pressures calculated in accordance with ASCE 7-05 are applied to tributary areas on the building. These loads result in forces that should be evaluated at connections and at stresses in structural members, or to the Main Wind Force Resisting System (MWFRS). Forces are also calculated for wall sheathing, roof panels, windows, and doors—all of which is referred to collectively as the components and cladding (C&C). Calculated wind pressures are largely dependant upon site location, topography, building shape and configuration, and building importance. Figure 3-4 is a section of a map showing areas along the East Coast of the United States that are subject to hurricanes. ASCE 7 sections that pertain to wind loads and loading combinations are:

- Section 2: Combinations of Loads, including different load combinations for V Zones and Coastal A Zones.
- Section 6: Wind Loads, which covers MWFRS and C&C. A discussion of windborne debris is also included in this section.

Figure 3-4.
The hurricane-prone regions along the coastline of the United States. This map is based upon ASCE 7-05, Figure 6-1.

3.2.3 ASCE 24 Requirements

ASCE develops and maintains the consensus standard ASCE 24-05. This standard specifies minimum requirements for flood-resistant design and construction of buildings and structures located in flood hazard areas, including floodways and coastal high-hazard areas. The standard applies to new buildings and existing structures that are not designated as historic structures but which are undergoing substantial repair or improvements.

Basic design requirements address flood loads and load combinations, elevation of the lowest floor, recommendations about the DFE, foundation requirements and geotechnical considerations, use of fill, and anchoring and connections. As a function of the type of flood hazard area, enclosures may need breakaway walls or must meet requirements for flood openings (either prescriptive or engineered). ASCE 24-05 does not address wind hazards specifically, but does reference the fact that load combinations on structures shall be in accordance with ASCE 7-05, which would include wind loads.

For buildings in coastal high-hazard areas, V Zones and Coastal A Zones, ASCE 24-05 includes specifications for the design of pile, post, pier, column, and shear wall foundations. Considerable detail is specified for pilings as a function of pile types and connections.

ASCE 24-05 states that residential structures in V Zones and Coastal A Zones are required to have open foundations and shall have the lowest horizontal structural member of the lowest floor positioned at or above the DFE. The minimum elevation requirements are based upon the structural member's orientation to the direction of waves approaching. For parallel members, the requirement is DFE and the perpendicular members are required to be BFE + 1 or DFE (whichever is higher).

The following topics are also addressed within ASCE 24-05: materials, dry and wet floodproofing, utility installations, building access, and miscellaneous construction (e.g., decks, porches, patios, garages, chimneys and fireplaces, pools, and above- and below-ground storage tanks). It is important to note that some sections of ASCE 24-05 exceed the minimum requirements set forth in the NFIP; specifically freeboard requirements. A structure designed to ASCE 24-05 standards, which include freeboard criteria, would likely perform better during a design event (by resisting flood loads better) than a building not constructed to the minimum NFIP criteria that recommend, but do not require freeboard. Until such standards and approaches are directly incorporated into the building codes or regulations, without options, then these standards and approaches should be considered best practices and not requirements.

3.3 Coastal Barrier Resources Act of 1982

The Coastal Barrier Resources Act (CBRA) of 1982 was enacted to protect vulnerable coastal barriers from development; minimize the loss of life; reduce expenditures of Federal revenues; and protect fish, wildlife, and other natural resources. This law established the Coastal Barrier Resources System (CBRS), which is managed by the Department of the Interior's (DOI) United States Fish and Wildlife Service (USFWS). The law restricts Federal expenditures and financial assistance that could encourage the development of coastal barriers. The CBRA does not prohibit privately financed development; however, it does prohibit most new Federal financial assistance-including federally backed flood insurance-in locations within the CBRS (also referred to as CBRA areas). Flood

insurance may not be sold for buildings within the CBRS that were constructed or substantially improved after October 1, 1983. The financial risk of building in these areas is transferred from Federal taxpayers directly to those who choose to reside in or invest in these areas.

NOTE

Any building within a Coastal Barrier Resources System (CBRS) area that is constructed or substantially improved after October 1, 1983 (or the date of designation for areas added to the system after 1991) is not eligible for federal flood insurance or other federal financial assistance. The same restriction applies to substantially damaged buildings in a CBRS area that are repaired or renovated after those dates.

CBRS boundaries are shown on a series of maps produced by DOI. In addition, FEMA has transferred CBRS boundaries to many FIRMs so that insurance agents and underwriters may determine eligibility for flood insurance coverage. Before constructing a new building, substantially improving an existing building, or repairing a substantially damaged building, the designer or property owner should review the FIRM and confirm for the building official that the property is not within the CBRS. If the structure is considered within the CBRS, the building official should notify the designer or property owner of any special ordinances specific to structures within the CBRS. In situations where the FIRM does not allow for a definitive determination, the designer or property owner should consult local officials. In some situations, it may be necessary to request a determination from USFWS, based upon DOI maps.

3.4 Coastal Zone Management Regulations

The Coastal Zone Management (CZM) Act of 1972 encourages the adoption of coastal zone policies by coastal states acting in partnership with the Federal government. CZM regulations have been adopted by 34 states and territories. For information on the status of state and national CZM programs, visit the Web site of the National Oceanic and Atmospheric Administration (NOAA) at http://oceanservice.noaa.gov/topics/coasts/management/.

Each state's CZM program contains provisions to:

- Protect natural resources
- Manage development in high-hazard areas
- Manage development to achieve quality coastal waters
- Give development priority to coastal-dependent uses
- Have orderly processes for the siting of major facilities
- Locate new commercial and industrial development in, or adjacent to, existing developed areas
- Provide public access for recreation
- Redevelop urban waterfronts and ports, and preserve and restore historic, cultural, and aesthetic coastal features
- Simplify and expedite governmental decision making actions

- Coordinate state and Federal actions
- Give adequate consideration to the views of Federal agencies
- Assure that the public and local governments are consulted during coastal decision making
- Comprehensively plan for and manage living marine resources

Most state coastal zone regulations control construction seaward of a defined boundary or setback line, such as a dune or road. Many states regulate or prohibit construction seaward of a second setback line, which is based upon erosion. Some setback lines are updated when erosion rates are assessed; lines that follow physical features (such as dune lines) are not fixed and "float" as the physical feature shifts over time. Other examples of state coastal regulations include the placement or prohibition of shore protection structures and the protection of dunes. These restrictions should be carefully considered by state and local regulatory officials because guidance on the regulations is site-specific to coastal conditions within that area.

3.5 Use of the NFIP and Code Crosswalk

To provide information on the guidance in each document or to identify the location of the information within the document, this section provides a useful crosswalk summary of NFIP regulations (as well as the IBC, IRC, ASCE 24-05, and ASCE 7-05) for each coastal zone. In many cases, information is provided about whether the guidance is a requirement of that document or a best-practices recommendation. The crosswalk refers to the BFE; however, some jurisdictions may include freeboard, and, in these cases, the guidance should be understood as the DFE.

Table 3-1 was developed using Appendix B and Appendix C of *Reducing Flood Losses Through the International Codes* (ICC/FEMA, 2nd Edition, 2005) and updated to reflect the 2006 versions of the IBC and IRC. This crosswalk summary is intended to provide guidance on the locations of applicable code sections. It is not a complete list, and the local official should be encouraged to consult that particular code.

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Table 3-1. Code Crosswalk

	NFIP	V Zone	Coastal A
GENERAL REQUIREMENTS			
Design and Construction	**60.3(a)(3)(i)** New construction and substantial improvements to be designed and adequately anchored to prevent flotation, collapse, or lateral movement.	**Requirement**: Building and its foundation must be designed, constructed, and anchored to prevent flotation, collapse, and lateral movement due to simultaneous wind and water load.	**Requirement**: Building must be designed, constructed, and anchored to prevent flotation, collapse, and lateral movement resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy. **Recommendation**: Same as V Zone.
Materials	**60.3(a)(3)(ii)** New construction and substantial improvements to be constructed with materials resistant to flood damage.	**Requirement**: Structural and nonstructural building materials at or below the BFE must be flood-resistant.	**Requirement**: Structural and nonstructural building materials at or below the BFE must be flood resistant.
Siting	**60.3(d)(3)** Prohibit floodway encroachment unless no impact on flood levels is demonstrated. **60.3(e)(3)** All new construction shall be landward of mean high tide. **60.3(e(7)** Alteration of sand dunes and mangrove stands that increases	**Requirement**: All new construction shall be landward of mean high tide; alteration of sand dunes and mangrove stands that increases the potential of flood damage is prohibited. **Recommendation**: Site new construction landward of the long-term erosion setback and landward of the area subject to erosion during the 100-year coastal flooding event.	**Requirement**: Encroachments into the SFHA are permitted as long as they do not increase the BFE by more than 1 foot; encroachments into the floodway are prohibited. **Recommendation**: Same as V Zone.
FOUNDATION			
Structural Fill	**60.3(e)(6)** Prohibit the use of fill for structural support of buildings in V Zones.	**Prohibited**	Allowed, but not recommended; compaction required where used; protect against scour and erosion.
Solid Foundation		**Prohibited**	Allowed, but not recommended.
Open Foundation		**Required**	Not required, but recommended.
Lowest Floor Elevation (non V Zone)	**60.3(c)** Require all new and substantially improved structures: (2) to have the lowest floor elevated to or above the flood elevation or, (3) be floodproofed (nonresidential only)	N/A	**Requirement**: Top of floor must be at or above BFE **Recommendation**: Elevate bottom of lowest horizontal structural member to or above BFE
Bottom Lowest Horizontal Structural Member	**60.3(e)(4)** Require all new and substantially improved construction to be elevated on pilings and columns so that: **(i)** bottom of lowest horizontal structural member is at or above the flood elevation, **(ii)** pile or column foundation and structure are anchored to resist flotation, collapse, and lateral movement due to wind and water loads; registered design professional to develop or review the design, specifications, and plans and provide certification.	**Requirement**: Bottom must be at or above the BFE.	Allowed below BFE but not recommended. **Recommendation**: Same as V Zone.
Orientation of Lowest Horizontal Structural Member	None	No requirement **Recommendation**: Orient perpendicular to wave crest	No requirement
Freeboard	None	Not required, but recommended	Not required, **but recommended**
Enclosures Below the BFE (non V Zones)	**60.3(c)(5)** Fully enclosed areas below elevated buildings are to be: limited in use (parking, access, storage); provided with flood openings that meet minimum criteria or are designed by a registered design professional.	N/A	Allowed, but **not recommended**; if an area is fully enclosed, the enclosure walls must be equipped with openings to equalize hydrostatic pressure; size, location, and covering of openings governed by regulatory requirements. **Recommendation**: If enclosure if constructed, use breakaway walls, open lattice, or screening (as required in V zones).
Enclosures Below the BFE (V Zones)	**60.3(e)(5)** Enclosed areas, if any, are to be constructed with non-supporting, breakaway walls, lattice, or screening intended to collapse under wind and water loads; uses limited to parking, building access, or storage.	Prohibited, except for breakaway walls, open lattice, and screening.	N/A
Sanitary Sewer	**60.3(a)(6) (i)** New/replacement sanitary sewage system designed to minimize/eliminate infiltration/discharges **(ii)** on-site waste disposal systems located to avoid impairment or contamination.		
Utilities	**60.3(a)(3)(v)** Electrical, heating, ventilation, plumbing, and air-conditioning equipment and other service facilities to be designed and/or located to protect components.	**Requirement:** Must be designed, located, and elevated to prevent floodwaters from entering and accumulating in components during flooding.	**Requirement**: Must be designed, located, and elevated to prevent floodwaters from entering and accumulating in components during flooding.
CERTIFICATION			
Permits	**60.3(b)(1)** Require permits for all development, including placement of manufactured homes.	V Zone Certificate, Breakaway Wall Certificate, and Elevation Certificate	Elevation Certificate
MANUFACTURED HOUSING			
General	**60.3(b)(8)** Require installation of MFH using methods to minimize flood damage, including anchoring, and to resist wind forces.		

Table 3-1. Code Crosswalk Continued

A Zone	IBC	IRC	ASCE 24 and ASCE 7	Other
GENERAL REQUIREMENTS				
Requirement: Building must be designed, constructed, and anchored to prevent flotation, collapse, and lateral movement resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy. Recommendation: Same as V Zone	1605.2.2 (reference ASCE 7) 1605.3.1.2 (reference ASCE 7) 1612.4 (reference ASCE 24) 1612.5.2, 3403.1.1	R301.1 R301.2.4 R323.1	ASCE 24 Sec. 5.6 ASCE 24 Sec. 1.5.1	
Requirement: Structural and non-structural building materials at or below the BFE must be flood resistant.	801.1.3, 1403.5	R324.1.7	ASCE 24 Ch. 5	FEMA TB #2 FEMA TB #8
Requirement: Encroachments into the SFHA are permitted as long as they do not increase the BFE by more than 1 foot; encroachments into the floodway are prohibited.	App. G 103.5 App. G 103.6 App. G 103.7 App. G 401.1 App. G 401.2	R301.2.4 R324.3.1	ASCE 24 Sec. 2.3 ASCE 24 Ch. 3 ASCE 24 Sec. 4.3	FEMA EMI IS-9, FEMA FIA-12
FOUNDATION				
Allowed; compaction required where used; protect against scour and erosion.	App. G 401.1	R324.3.2	ASCE 24 Sec. 2.4	FEMA TB #5
Allowed		R324.2.3	ASCE 24 Sec. 2.5 ASCE 7 Sec. 5.4.4.2	FEMA TB #5
Allowed			ASCE 7 Sec. 5.4.4.1 ASCE 24 Sec 4.5.5	FEMA TB #5
Requirement: Top of floor must be at or above BFE	1603.1.6 1612.4	R105.3.1.1 R324.2.1 R324.1.4	ASCE 24 Sec. 1.5.2 ASCE 24 Sec. 2.5 ASCE 24 Ch. 5 ASCE 24Ch. 7	FEMA 259 FEMA TB #3 FEMA 348
Allowed below BFE but not recommended. **Recommendation: Same as V Zone**	1603.1.6 1612.4 1612.5.2	R324.2.1 R324.3.2 R323.3.5	ASCE 24 Sec. 4.4 ASCE 24 Sec. 2.5 ASCE 24 Ch. 5	FEMA 55, FEMA TB #8 FEMA TB #5
No requirement			ASCE 24 Sec 4.4	No requirement
Not required, but recommended				
Allowed, but not recommended; if an area is fully enclosed, the enclosure walls must be equipped with openings to equalize hydrostatic pressure; size, location, and covering of openings governed by regulatory requirements.	1203.3.2 1403.5 1612.4 1612.5.1	R324.2.2 R408.7	ASCE 24 Sec. 2.6 ASCE 24 Sec 4.6	FEMA TB #1
NA	1403.5 1403.6 1612.4 1612.5.2	R324.3.4 R324.3.5	ASCE 24Sec. 4.6 ASCE 7 Sec. C5.3.3	FEMA 55 FEMA TB #5, FEMA TB #9
	1403.6 App. G 401.3	R324.1.6	ASCE 24 Sec. 7.3.4	FEMA 348
Requirement: Must be designed, located, and elevated to prevent flood waters from entering and accumulating in components during flooding.	1403.6 1612.4 App. G 701	R324.1.5 IFGC 301, R G2404 R M1601.3.8	ASCE 24 Ch. 7	FEMA 348, FEMA TB #4
CERTIFICATION				
Elevation Certificate	App. G 101.3 App. G 103 App. G 104	R104.2, R105.3.1.1 App. E App. J		FEMA EMI IS-9
MANUFACTURED HOUSING				
	App. G 501	R324.1.8, App. AE101	NA	FEMA 85