2 Regulatory Requirements

Most flood retrofitting projects are regulated by local floodplain, zoning, and building codes, regulations, and ordinances. In addition to governing the extent and type of activities allowable in the regulatory floodplain, these codes and ordinances set construction standards and regulations. These construction standards and regulations must be followed in new construction as well as in substantial improvement and repair of substantially damaged buildings. The portions of these ordinances dealing with retrofitting are generally derived from guidance issued by FEMA under the NFIP, and USACE.

This chapter discusses the typical community floodplain management and building code environment, including:

- the various tenets of the NFIP;
- the role of local officials in a retrofitting project; and
- the compatibility of items covered in international building codes with the NFIP.

NOTE

In individual communities, local regulations are the mechanism by which NFIP requirements are enforced. The reader is encouraged to contact local floodplain management and building code officials to determine if more restrictive requirements are in place.

Each jurisdiction may adopt standards that are more restrictive than the minimum NFIP requirements, but this section will examine only the minimum Federal regulations governing construction in a SFHA. Adoption of national model building codes establishes a certain level of consistency between State and local jurisdictions. However, State and local governments often amend or adopt only portions of the national model building codes, so the extent to which local building codes are more, or less, stringent than minimum model code requirements can vary widely.

2.1 National Flood Insurance Program

The NFIP is a voluntary program that operates through a partnership between the Federal Government and individual communities such as State, Tribal governments, counties, parishes, and incorporated cities, towns, townships, boroughs, and villages. The NFIP provides federally backed flood insurance to property owners and renters in participating communities. In return, each community adopts and enforces floodplain management regulations that meet or exceed the minimum NFIP requirements. The creation of the NFIP was a major step in the evolution of floodplain management. During the 1960s, Congress became concerned with problems related to the traditional methods of dealing with flood damage. It concluded:

- flood protection structures are expensive and cannot protect everyone;
- people are still building in floodplains and, therefore, are risking disaster;
- disaster relief is inadequate and expensive;
- the private insurance industry cannot sell affordable flood insurance because only those at significant risk will buy it; and
- Federal flood control programs are funded by all taxpayers, but they primarily help only those who live in the floodplains.

CROSS REFERENCE

The floodplain management requirements of the NFIP are listed in the Code of Federal Regulations (CFR) Title 44, Chapter 1, Section 60.3 (44 CFR 60.3).

In 1968, Congress passed the National Flood Insurance Act to correct some of the shortcomings of the traditional flood control and flood relief programs. The Act created the NFIP to:

- guide future development away from flood hazard areas;
- require that new and substantially improved buildings be constructed to resist flood damage;
- provide floodplain residents and owners with financial assistance after floods, especially after smaller floods that do not warrant Federal disaster aid; and
- transfer some of the costs of flood losses from the taxpayers to floodplain property owners through flood insurance premiums.

Congress originally charged the Department of Housing and Urban Development's (HUD's) Federal Insurance Administration (FIA) with responsibility for the program. In 1979, the FIA and the NFIP were transferred to the newly created Federal Emergency Management Agency. Currently, the NFIP is administered by the Federal Insurance and Mitigation Administration (FIMA) within FEMA.

NOTE

To obtain information on repetitive loss structures in your community, contact your State Community Rating System (CRS) program coordinator or your FEMA Regional office.

FEMA has focused particular attention on mitigating buildings and facilities subject to repetitive losses. A building is considered to be a repetitive loss structure when it has had at least two losses of $1,000 or more within any

10-year period. There is an even more concerted effort to mitigate severe repetitive loss (SRL) properties. Severe repetitive loss is defined as either:

(a) at least four NFIP claim payments (including building and contents) over $5,000 each, and the cumulative amount of such claims payments exceeds $20,000; or

(b) at least two separate claims payments (building payments only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building.

These buildings represent significant losses for the NFIP each year. FEMA is continuing to focus NFIP and retrofitting mitigation efforts on properties that have sustained or are likely to sustain repetitive losses and severe repetitive losses. Possible FEMA funding sources for these activities include:

- Increased Cost of Compliance (ICC) coverage
- Hazard Mitigation Assistance (HMA) grant programs
  - Hazard Mitigation Grant Program (HMGP)
  - Pre-Disaster Mitigation (PDM)
  - Flood Mitigation Assistance (FMA)
  - Repetitive Flood Claims (RFC)
  - Severe Repetitive Loss (SRL)

See Appendix A for additional information on these sources of funding. For more information on FEMA and non-FEMA sources of funding, readers are encouraged to contact their State NFIP and HMGP Coordinators or State Hazard Mitigation Officers.

2.1.1 Flood Hazard Information

The requirements of the NFIP are based on the BFE, which is the flood level that has a 1-percent chance of being equaled or exceeded in any given year. The associated flood is called the base flood event. Communities that participate in the NFIP's Regular Program typically have a detailed Flood Insurance Study (FIS), which presents flood elevations of varying frequency, including the base flood, areas inundated by the various magnitudes of flooding, and floodway boundaries. This information is presented on a Flood Insurance Rate Map (FIRM). Retrofitting designers may use data from FIRMs and FIS reports to determine floodplain limits, flood depth, flood elevation, and flood frequency.

WARNING

FIRMs use the North American Vertical Datum (NAVD) of 1988. Older FIRMs may use National Geodetic Vertical Datum (NGVD) of 1929 Communities normally use NAVD 88 for surveying purposes; if the community's FIRM uses NGVD 29, then NGVD 29 must be used for all elevations on FEMA Elevation Certificates and other NFIP applications.

2.1.1.1 Flood Insurance Rate Maps

A FIRM is the official map of an NFIP community that delineates the SFHAs and the risk premium zones applicable to the community. FIRMs are developed based on detailed study and analysis, including historic,

meteorological, hydrologic, and hydraulic data. Communities and homeowners can use the FIRM to locate properties and buildings in flood insurance risk areas. FIRMs can be obtained through a community's floodplain manager, or online at the FEMA Map Service Center (MSC) (http://www.msc.fema.gov/). For more instruction on reading a FIRM, view the FIRM tutorial course (http://www.fema.gov/plan/prevent/fhm/ot_firmr.shtm). Digitized FIRMs are also known as digital FIRMs (DFIRMs). Beginning on or after October 1, 2009, FEMA will provide a single paper flood map and FIS to each mapped community. FEMA will convert all other distribution of maps and FIS reports for digital delivery.

A FIRM generally shows areas inundated during the base flood as either Zone A or Zone V. An example of a DFIRM for riverine flooding is shown in Figure 2-1; a DFIRM for coastal flooding is shown in Figure 2-2.

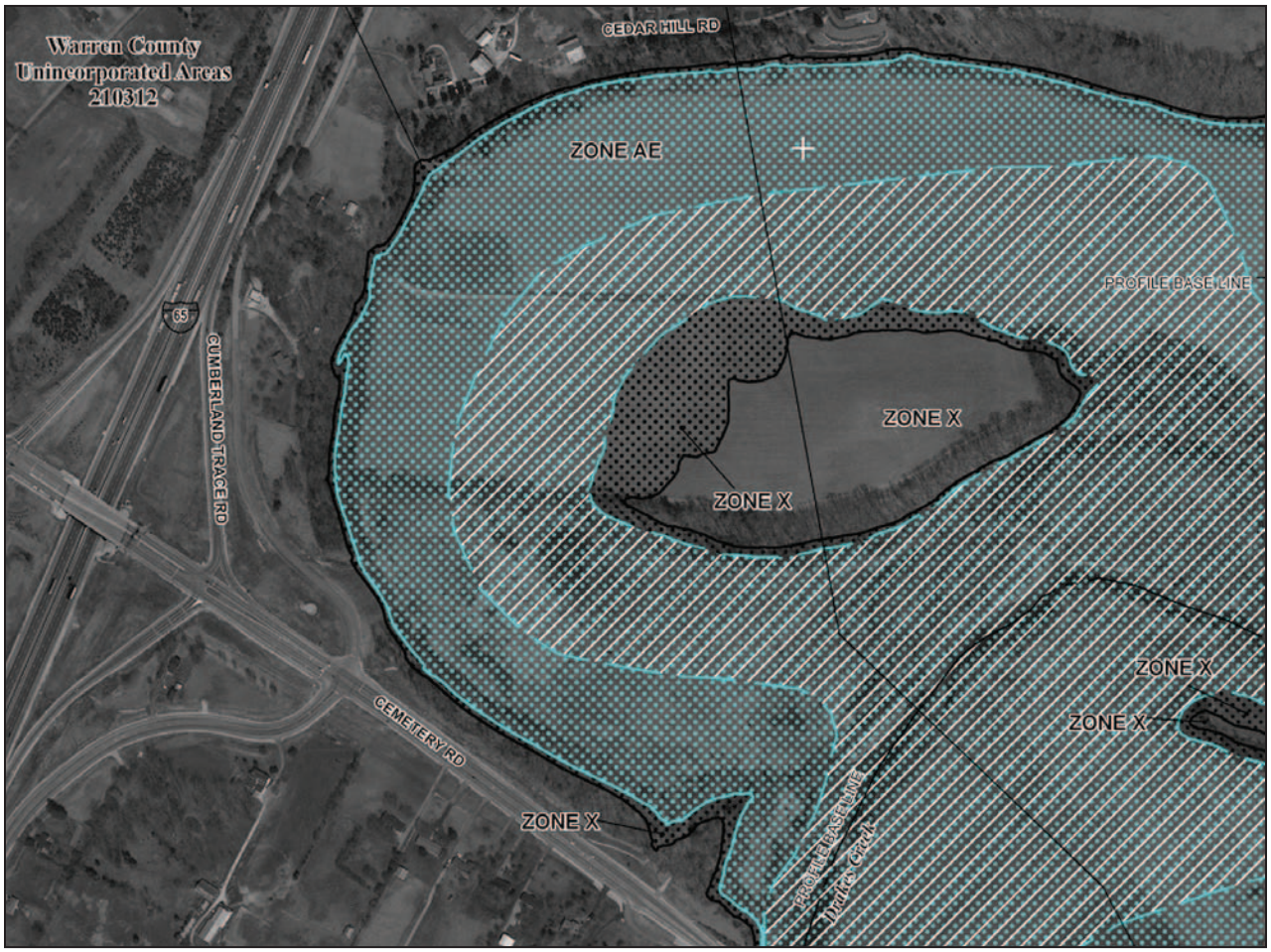

Figure 2-1. Typical DFIRM for riverine flooding

The insurance zone designations shown on FIRMs indicate the severity or type of flooding in the area. Areas of moderate to low risk include:

- **Zone X (shaded) and Zone B:** Areas of moderate flood hazard, usually depicted on FIRMs as between the limits of the base and 0.2-percent-annual-chance floods (also called the 500-year flood). These zones

Figure 2-2. Typical DFIRM for coastal flooding showing the Limit of Moderate Wave Action (LiMWA)

are also used to designate base floodplains with low risk of hazards, such as those with average depths of less than 1 foot or drainage areas less than 1 square mile, and areas protected by levees from the base flood. Zone B is used on older FIRMs;

- **Zone X (unshaded) and Zone C:** Areas of minimal flood hazard, usually depicted on FIRMs as above the 0.2-percent-annual-chance flood level. These zones may have flooding that does not meet the criteria to be mapped as a SFHA, such as ponding and local drainage problems. Zone C is used on older FIRMs; and
- **Zone D:** Areas of undetermined, but possible flood hazards.
- **Zone A:** The SFHA subject to inundation by the 1-percent-annual-chance flood event (except Zone V) mapped on a community's FIRM. The six types of Zone A are:
  - **A:** Determined using approximate methodologies where no BFE or flood depths are shown;
  - **AE and A1-A30:** Determined using detailed methodologies where the FIRM shows a BFE. Zone AE delineations are used on newer FIRMs instead of numbered zones;
  - **AH:** Shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. BFEs derived from detailed analysis are shown;

- **AO:** Shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average flood depths derived from detailed analysis are shown. Some Zone AOs have been designated in areas with high flood velocities, such as alluvial fans and washes;
- **AR:** Areas that result from the decertification of a previously accredited flood protection system that is determined to be in the process of being restored to provide base flood protection; and
- **A99:** Areas subject to the 1-percent-annual-chance flood event, but which will ultimately be protected upon completion of an under-construction Federal flood protection system. No BFEs or depths are shown. Zone A99 may only be used when the flood protection system has reached specified statutory progress toward completion.

Starting in 2008, FEMA began mapping the LiMWA in coastal areas. The LiMWA represents the landward limit of the 1.5-foot wave (see Figure 2-2). The area between the LiMWA and the Zone V limit is known as the Moderate Wave Action (MoWA) area in flood maps, and the Coastal A Zone for building code and standard purposes (such as in ASCE 24, *Flood Resistant Design and Construction*). This area is subject to wave heights between 1.5 and 3 feet during the base flood. The area between the LiMWA and the landward limit of Zone A due to coastal flooding is known as the Minimal Wave Action (MiWA) area, and is subject to wave heights less than 1.5 feet during the base flood.

NOTE

There presently are no NFIP floodplain management requirements or special insurance ratings associated with the designation of the LiMWA. However, in areas designated with a LiMWA, communities are encouraged to adopt Zone V requirements rather than the minimum NFIP requirements in MoWA areas to address the increased risks associated with waves and velocity action.

- **Zone V:** The Coastal High Hazard Area subject to inundation by the 1-percent-annual-chance flood event and high-velocity wave action. There are two types of Zone V, which correspond to the Zone A designations based on the level of detailed analysis used:
  - **V:** No BFEs or flood depths are shown; and
  - **VE and V1-30:** The FIRM shows a BFE. Zone VE delineations are used on newer FIRMs instead of numbered zones.

ASCE 24 warns that even the latest FIRMs and FISs may be based on limited or incomplete information and suggests that the community should always be contacted to obtain the latest information. Designers should not determine a zone designation from a FIRM with a higher degree of precision than intended. Several aspects of flood hazards and mapping should be considered: (1) the determination of flood hazard areas and maps involves detailed analysis, but also assumptions and judgment made by modelers; (2) the base flood is a statement of probability; (3) changes in land use over time contribute to increases in flood elevations in riverine areas; (4) coastal flood mapping is sensitive to topography, which may change over time due to erosion and development; (5) base maps do not include sufficient scale to capture all ground elevations; and (6) the scale of most FIRMs is such that the width of the lines delineating zones can be a factor in determining whether a structure is in or out of a certain flood zone.

2.1.1.2 Flood Insurance Studies

FIRMs are based on the information provided in an FIS. An FIS is based on detailed engineering studies. In addition to providing detailed information on the hydrology and hydraulics of the community, the FIS provides a narrative of the community's flood history and sources of flooding. FISs show discharges and flood profiles for riverine floodplains, and stillwater elevations and wave height transects for coastal floodplains. FISs can be obtained through a community's floodplain manager, or online at the FEMA Map Service Center (http://www.msc.fema.gov/). For more instruction on reading an FIS, view the FIS tutorial course (http://www.fema.gov/plan/prevent/fhm/ot_fisr.shtm).

Riverine Floodplains: An FIS for riverine floodplains describes in detail how the flood hazard information – including floodways, discharges, velocities, and flood profiles for major riverine areas – was developed for each community.

The area of the 100-year riverine floodplain is often divided into a floodway and a floodway fringe. The floodway is the channel of a watercourse plus any adjacent floodplain areas that must be kept free of encroachment so that the cumulative effect of the proposed encroachment, when combined with all other existing or proposed encroachments, will not increase the BFE more than 1 foot at any point within the community.

The area between the floodway and 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the base flood by more than 1 foot at any point. Many States and communities limit the allowable increase to less than 1 foot. Figure 2-3 shows a typical riverine floodplain cross section, including the floodway and floodway fringe.

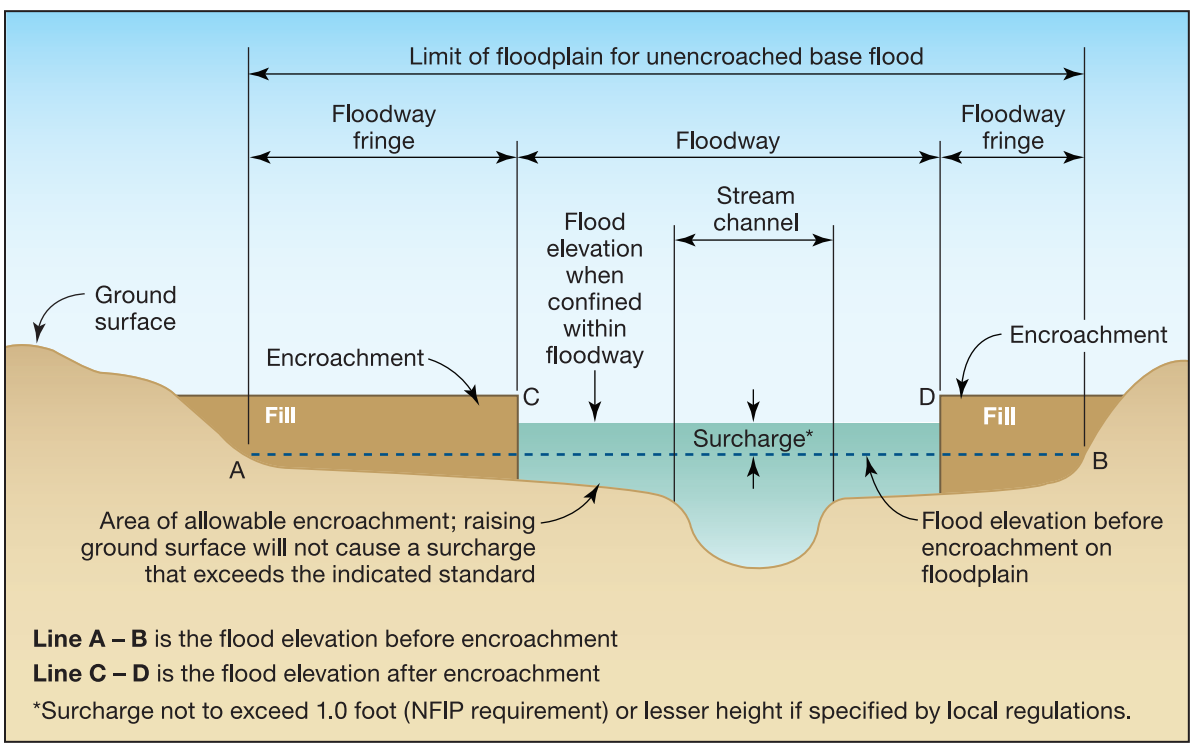

Figure 2-3. Typical riverine floodplain cross section

Discharges are determined for various locations and flood frequencies along the stream and are presented in a summary table in the FIS report. Flood profiles depict various flood frequency and channel bottom elevations along each studied stream. For most streams with significant flood hazards, the FIS for riverine floodplains normally contains discharges and water-surface elevations for the 10-, 50-, 100-, and 500-year floods, which have annual exceedance probabilities of 10, 2, 1, and 0.2 percent, respectively.

CROSS REFERENCE

The example in Chapter 4 includes an example of a Summary of Discharges Table and Riverine Flood Profile.

Coastal Floodplains: In coastal communities that contain both riverine and coastal floodplains, the FIS may contain information on both coastal and riverine hazards. The coastal analysis includes the determination of the storm surge stillwater elevations for the 10-, 2-, 1-, and 0.2-perecent-chance floods (commonly referred to as the 10-, 50-, 100-, and 500- year floods, respectively) as shown in Table 4-2.

NOTE

This manual does not cover design issues in Coastal High Hazard Areas (Zone V). For information on coastal design and construction, refer to FEMA's *Coastal Construction Manual* (FEMA P-55, Fourth Edition, 2011).

These stillwater elevations represent the potential flood elevations from tropical storms (hurricanes and typhoons), extra-tropical storms (nor'easters), tsunamis, or a combination of any of these events. The FIS wave analysis includes an estimate of the expected beach and dune erosion during the base flood and the increased flood hazards from wave heights and wave runup.

CROSS REFERENCE

The example in Chapter 4 includes an example of a Summary of Coastal Stillwater Elevations Table.

The increases from wave heights and runup are added to the stillwater elevations to yield the regulatory BFE. Figure 2-4 illustrates the wave height transect showing the effects of physical features on the wave heights and corresponding BFE.

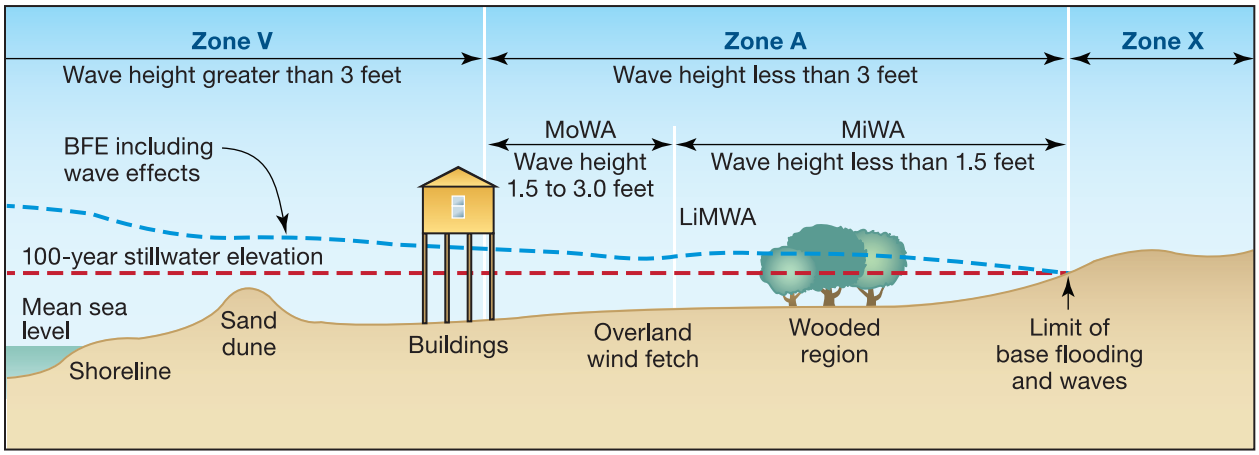

Figure 2-4. Wave height transect showing LiMWA, MoWA, and MiWA

2.1.2 Floodplain Management Regulations

The floodplain management aspects of the NFIP are implemented by communities. A "community" is a governmental body with the statutory authority to enact and enforce development regulations. The authority of each unit of government varies by State. Eligible communities can include cities, villages, towns, townships, counties, parishes, States, and Indian Tribes. Over 21,000 communities participate in the NFIP.

To participate in the NFIP, communities must, at a minimum, regulate development in their floodplains in accordance with the NFIP criteria and State regulations. To do this, communities must require a permit before any development in the regulatory floodplain proceeds. Before the permit is issued, the community must ensure that two basic criteria are met:

- all new construction, substantial improvements, and repairs of substantial damage will be protected from damage by the base flood; and
- new floodplain development will not aggravate existing flood problems or increase damage to other properties.

CROSS REFERENCE

FEMA has developed two resources to assist State and local officials with NFIP requirements for substantially improved/substantially damaged buildings. The *Substantial Improvement/ Substantial Damage Desk Reference* (FEMA P-758, 2010c) provides practical guidance and suggested procedures to implement the NFIP requirements for substantially improved or substantially damaged buildings.

The Substantial Damage Estimator (FEMA P-784, 2010d) software assists State and local officials in determining substantial damage using data collected during the evaluation process.

Several definitions are needed to guide the designer through floodplain management regulations. The NFIP definitions of key terms are provided below.

Basement: Any area of the building having its floor subgrade (below ground level) on all sides.

Enclosure: That portion of an elevated building below the lowest elevated floor that is either partially or fully shut in by rigid walls.

Lowest Floor: The lowest floor of the lowest enclosed area (including basement). An unfinished or flood-resistant enclosure, usable solely for parking of vehicles, building access, or storage in an area other than a basement area is not considered a building's lowest floor, provided that such enclosure is not built so as to render the structure in violation of the applicable non-elevation design requirement of 44 CFR 60.3.

Post-FIRM: A post-FIRM building (for floodplain management purposes) is a building for which the start of construction post-dates the effective date of the community's NFIP-compliant floodplain management ordinance.

NOTE

The definitions of pre-FIRM and post-FIRM are different for insurance and floodplain management purposes. See Section 2.1.3 for the insurance definitions.

Pre-FIRM: A pre-FIRM building (for floodplain management purposes) is a building for which the start of construction occurred before the effective date of the community's NFIP-compliant floodplain management ordinance.

Structure: For floodplain management purposes, a walled and roofed building, including a gas or liquid storage tank, that is principally above ground, as well as a manufactured home.

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.

Substantial Improvement: Any reconstruction, rehabilitation, addition, or other improvement of a structure, the cost of which equals or exceeds 50 percent of the market value of the structure before the "start of construction" of the improvement. This term includes structures which have incurred "substantial damage," regardless of the actual repair work performed. The term does not, however, include either:

1. any project for improvement of a structure to correct existing violations of State or local health, sanitary, or safety code specifications which have been identified by the local code enforcement official and which are the minimum necessary to assure safe living conditions, or

2. any alteration of a "historic structure," provided that the alteration will not preclude the structure's continued designation as a "historic structure."

Under NFIP criteria, all new (post-FIRM) construction related to substantially improved or substantially damaged residential structures located within Zones A1-A30, AE, and AH must have the lowest floor at or above the BFE. Therefore, elevation and relocation are the retrofitting alternatives that enable a post-FIRM or a substantially improved or substantially damaged structure to be brought into compliance with the NFIP.

Utilizing the aforementioned definitions and local codes, the designer can begin to determine which retrofitting measures may be acceptable for each specific home.

2.1.3 Insurance Program

Federally-backed flood insurance is made available in communities that agree to implement NFIP-compliant floodplain management programs that regulate future floodplain development. Communities apply to participate in the program in order to make flood insurance and certain forms of Federal disaster assistance available in their community.

Everyone in a participating community can purchase flood insurance coverage, even for properties not located in mapped floodplains. Insurance provides relief for all floods, including those that are not big enough to warrant Federal disaster aid, as long as a general condition of flooding exists.

The Federal Government makes flood insurance available only in communities that adopt and enforce floodplain management regulations that meet or exceed NFIP criteria. Because the communities will ensure that future development will be resistant to flood damage, the Federal Government is willing to support insurance and help make it affordable.

The Flood Disaster Protection Act of 1973 expanded the program to require flood insurance coverage as a condition of Federal aid or loans from federally-insured banks and savings and loans institutions for buildings

located in identified flood hazard areas. Most communities joined the NFIP after 1973 in order to make this assistance available for their flood-prone properties.

NFIP flood insurance is available through many private flood insurance companies and independent agents, as well as directly from the Federal Government. All companies offer identical coverage and rates as prescribed by the NFIP.

For flood insurance rating purposes, residential buildings are classified as being either pre-FIRM or post-FIRM. Pre-FIRM construction is defined as construction or substantial improvement begun on or before December 31, 1974, or before the effective date of the community's initial FIRM, whichever is later. Post-FIRM construction includes construction or substantial improvement that began after December 31, 1974, or on or after the effective date of the community's initial FIRM, whichever is later.

Insurance rates for pre-FIRM buildings are set on a subsidized basis; while insurance rates for post-FIRM structures are set actuarially on the basis of designated flood hazard zones on the community's FIRM and the elevation of the lowest floor of the building in relation to the BFE. This rate structure provides owners an incentive to elevate buildings in exchange for receiving the financial benefits of lower insurance rates. Subsequent to substantial improvements, a pre-FIRM building will become a post-FIRM building for flood insurance rating purposes. Only elevation or relocation techniques may result in reduced flood insurance premiums or in eliminating the need for flood insurance.

To provide incentives for communities to adopt more stringent requirements, FEMA established the NFIP Community Rating System. For more information about the CRS, contact the NFIP Coordinating Agency for your State or the appropriate FEMA Regional Office. See also FEMA's CRS Web site (http://www.fema.gov/business/nfip/crs.shtm), which includes basic information and links to other CRS resources, including the CRS Resource Center (http://training.fema.gov/EMIWeb/CRS/).

2.1.4 NFIP Flood-Prone Building Performance Requirements

The NFIP has established minimum criteria and design performance requirements that communities participating in the NFIP must enforce for structures located in SFHAs. These criteria specify how a structure should be constructed in order to minimize or eliminate the potential for flood damage. Table 2-1 summarizes some of the key requirements of the NFIP for new construction, substantially improved, and substantially damaged buildings in Zone A.

CROSS REFERENCE

For more information on NFIP requirements and recommendations to exceed those requirements, see Appendix G of this Manual. Appendix G includes information for Zone A, Coastal A Zone, and Zone V.

FEMA, the USACE, the NRCS, and several State and local government entities have developed technical guidance manuals and information for public distribution to assist in the application of these requirements by the building community (i.e., building code and zoning officials, engineers, architects, builders, developers, and the general public). These resources (listed in Appendix F) contain guidelines for the use of certain techniques and materials for design and construction that meet the intent of the NFIP's general design criteria. These publications also contain information on the generally accepted practices for flood-resistant design and construction.

Table 2-1. Summary of Key NFIP Requirements for Zone A

Provision	Requirement
Design and Construction 44 CFR 60.3(a)(3)(i)	Building and foundation must be designed, constructed, and adequately anchored to prevent flotation, collapse, and lateral movement resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy.
Lowest Floor Elevation 44 CFR 60.3(c)(2)	Top of lowest floor must be at or above BFE.
Flood Damage-Resistant Materials 44 CFR 60.3(a)(3)(ii)	Structural and nonstructural building materials below the BFE must be flood damage-resistant.
Enclosures 44 CFR 60.3(c)(5)	Use of enclosures is restricted to parking of vehicles, building access, and storage. Walls of enclosures must have a minimum of two flood openings to allow passage of flood waters.
Utilities 44 CFR 60.3(a)(3)(iv)	Utilities and equipment must be located (elevated) at or above the BFE or designed to prevent flood waters from entering and accumulating in components during flooding.

FEMA has also been involved in a multi-year effort to incorporate the NFIP flood-damage-resistant design standards into the nation's model building codes and standards, which are then adopted by either States or communities. This effort has resulted in the inclusion of the standards in the International Building Code Series (I-Codes) published by the International Code Council and in ASCE 7, *Minimum Design Loads for Buildings and Other Structures* (ASCE, 2010) and ASCE 24, *Flood Resistant Design and Construction* (ASCE, 2005).

2.2 Community Regulations and the Permitting Process

Regulation of the use of floodplain lands is a responsibility of State and local governments and, in limited applications, the Federal Government (wetlands, navigable waterways, Federal lands, etc.). It can be accomplished by a variety of procedures, such as establishment of designated floodways and encroachment lines, zoning ordinances, subdivision regulations, special use permits, floodplain ordinances, and building codes. These land-use controls are intended to reduce or eliminate flood damage by guiding and regulating floodplain development.

TERMINOLOGY: FLOODWAY

The floodway is the channel of a river 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.

As was explained in Chapter 1, flood-prone communities that participate in the NFIP are required to adopt and enforce, at a minimum, NFIP-compliant floodplain regulations to qualify for many forms of Federal disaster assistance and for the availability of flood insurance. State and local floodplain ordinances are essentially the NFIP requirements with additional requirements set by the State or community. Many States and communities have more restrictive requirements than those established by the NFIP. In fact, State and community officials, using

knowledge of local conditions and in the interest of safety, may set higher standards, the most common of which are listed below.

- Freeboard means a factor of safety usually expressed in feet above a flood level for purposes of flood plain management. Freeboard tends to compensate for the many unknown factors that could contribute to flood heights greater than the height calculated for a selected size flood and floodway conditions, such as wave action, bridge openings, and the hydrological effect of urbanization of the watershed.
- Restrictive standards prohibit building in certain areas, such as the floodplain, conservation zones, and the floodway.
- The use of building materials and practices that have previously proven ineffective during flooding may be prohibited.
- The use and type of construction fill material may be further restricted by the higher standards adopted by some States and communities.

Before committing a significant investment of time and money in retrofitting, the design professional should contact the local building official for building code and floodplain management requirements and information on obtaining necessary permits. The ultimate decision on the application of building codes and floodplain requirements lies with the local building code official. When obtaining a permit and doing construction, the local building official or floodplain manager may add to the scope of work proposed by the homeowner in order to bring the retrofit project into compliance with applicable codes, standards, and regulations.

2.3 National Model Building Codes

The National Model Building Codes currently include the I-Codes and the National Fire Protection Association (NFPA) *Building Construction Safety Code* (NFPA 5000, 2009). The I-Codes have been widely adopted and used by local communities (in whole or in part with amendments). The I-Codes include a comprehensive set of requirements for building systems that meet or exceed the minimum NFIP requirements for flood-resistant design and construction requirements of the building types and systems for which they are written. The I-Codes include:

- IBC Appendix G addresses other NFIP requirements such as floodplain management issues;
- The *International Residential Code* (IRC) *for One- and Two-Family Dwellings;*
- *The International Existing Building Code* (IEBC);

WARNING

The adoption and enforcement of building codes and standards is not consistent across the United States. Codes and standards in some States and communities may be more restrictive than those in others. In addition, some communities have not adopted a building code. In communities where building codes have not been adopted or where the existing codes are not applied to one- and two-family residential buildings, design professionals, contractors, and others engaged in the design and construction of residential buildings are encouraged to follow the requirements of a model building code.

Some States, local governments, and communities, however, make their own amendments to the national model building codes. In these cases, it may be unclear if the adopted code is still consistent with NFIP floodplain management regulations.

- *The International Plumbing Code* (IPC);
- *The International Mechanical Code* (IMC);
- *The International Fuel Gas Code* (IFGC);
- *The International Private Sewage Disposal Code* (IPSDC); and
- *The International Fire Code* (IFC)

The NFPA 5000 addresses construction, protection, and occupancy, and is consistent with the flood-resistant design requirements of the NFIP.

At the time of this revision, 47 percent of floodprone communities have adopted a flood-resistant building code that meets or exceeds NFIP requirements (ISO 2011). Prior to the availability of the 2000 I-Codes, most communities adopted stand-alone floodplain management regulations. With the I-Codes, it is possible to integrate building codes and floodplain management into a single administrative process. In order to participate in the NFIP using this approach, all of the IBC, including Appendix G, must be adopted. Otherwise, not all "development," as defined by the NFIP, is regulated adequately. If Appendix G is not adopted, then provisions regulating "development" would need to be included in a stand-alone ordinance. The IRC includes flood-resistant construction requirements as part of the code and thus are adopted when the IRC is adopted. For more information about the IBC adoption process, contact the State or local building and permitting officials.

2.4 Consensus Standards

Numerous standards related to design and construction practices and construction materials are incorporated into a building code by reference rather than by inclusion of all of the text of the standard in the code. ASCE, with FEMA's assistance, worked to develop flood loads for inclusion in ASCE 7 and ASCE 24. These standards were developed by a committee of nationally recognized experts following the consensus standards process. Relevant consensus standards include:

- American Concrete Institute (ACI) 530, *Building Code Requirements for Masonry Structures.* ACI 530 is a referenced standard in the IBC and IRC;
- ASCE 7, *Minimum Design Loads for Buildings and Other Structures.* ASCE 7 is a referenced standard in the IBC, IRC, and NFPA 5000; and
- ASCE 24, *Flood-Resistant Design and Construction*. ASCE 24 is a referenced standard in the IBC and NFPA. The IRC allows, but does not require, the design provisions of ASCE 24.

ASCE 24 specifies minimum requirements for flood-resistant design and construction of structures located in flood hazard areas. The basic design requirements that are addressed in ASCE 24 include flood loads, load combinations, elevation of the lowest floor, foundation requirements, materials, wet and dry floodproofing, utility installations, and building access. In addition, ASCE 24 includes specifications for the design of pile, post, pier, column, and shear wall foundations.

The requirements of codes and standards meet or exceed the minimum NFIP requirements. Appendix G of this publication provides a summary of selected key NFIP provisions and recommended best practices for exceeding the requirements. It cross-references the I-Codes and the ASCE consensus standards.