Introduction to Retrofitting

Introduction

Every year, flooding causes over 90 percent of the disaster-related property damage in the United States and accounts for over 75 percent of all Presidential disaster declarations. In fact, over the last decade, property damage related to flooding has averaged well over 3.5 billion dollars a year. In 1996 alone, damages were estimated to have topped 6 billion dollars.

Although recent improvements in construction practices and regulations have made new houses less prone to flood damage, many existing houses continue to be damaged by flooding over and over again. National Flood Insurance Program (NFIP) insurance loss records show that more than 30,000 houses have been flooded more than once during the 6-year period beginning in 1990. These houses, by themselves, have accounted for over 1 billion dollars in flood damages, and their owners feel trapped in a never-ending cycle of flooding and repairing.

The good news is that there are ways that this cycle of repetitive flood damage can be broken. Homeowners across the country have protected their houses from flooding using the techniques described in this guide. One example (Figures 2-1 through 2-3) can be found in the Atlanta area, where some residential neighborhoods built in the 1960's were repeatedly flooded by a nearby stream.

After their house flooded for the second time, one family decided to do something. They hired a contractor, who elevated the house on concrete piers so that it would be above the level of future floods.

Figure 2-1
This house near Atlanta was flooded several times. During the largest flood, the water reached as high as 2 feet above the first floor.

Figure 2-2
The house was elevated in a way that added to both its appearance and its value.

Figure 2-3
Now the house (in the background) is protected from flooding, unlike the flooded house in the foreground.

At the outset of the project, the homeowners were concerned about how the house would look after it was elevated. But once construction was complete, the concerns proved groundless. Below the elevated house, traditional latticework was installed in the spaces between the support columns. Access to the front door is now provided by a well-designed double staircase that also serves as an architectural focal point. In addition to providing protection from future floods, elevating the house created a space below that could be used for parking and storage. This retrofitting method worked so well that other property owners in the neighborhood have chosen to protect their houses the same way.

In other areas where flooding has caused repeated damage, entire houses have been moved outside the flood hazard area or protected by floodwalls and levees designed as attractive landscaping features. As you read further in this guide, you will see that it is possible to protect your house from flooding while preserving or even enhancing its attractiveness and value.

NOTE

Any retrofitting project you undertake must meet the legal requirements of your community, including the floodplain management ordinances your community adopted to participate in the NFIP. By enforcing these ordinances, your community helps reduce future flood damages. As explained later in this chapter, the ordinances are based on the 100-year flood, also referred to as the "base flood." Remember these terms; you will encounter them many times as you read this guide. For further information, see the section *Federal, State, and Local Regulations* on page 20.

NOTE

Retrofitting specifically for earthquake hazards is often referred to as "rehabilitation."

What Is "Retrofitting"?

Retrofitting is making changes to an existing building to protect it from flooding or other hazards such as high winds and earthquakes. You have already seen an example of these changes, and you'll learn more in the following chapters. But you may be wondering at this point why retrofitting is necessary. Why aren't houses and other buildings constructed in such a way that they won't need these changes?

One reason is that construction technology, including both methods and materials, continues to improve, as does our knowledge of hazards and their effects on buildings. Many houses existing today were built when little was known about where and how often floods and other hazardous events would occur or how buildings should be protected, and houses being built today may benefit from improvements based on what we learn in the future. As a result, retrofitting has become a necessary and important tool in **hazard mitigation**.

DEFINITION

Hazard mitigation is action taken to reduce or eliminate long-term risk to people and property from hazards such as floods, hurricanes, earthquakes, and fires.

Types of Flooding

This guide focuses primarily on retrofitting for flood protection. If you decide to retrofit your house, you'll need to be aware of other potential hazards as well, such as high winds and earthquakes. They are discussed later, but first it is important that you understand flooding – where and how it occurs, the nature of the threat it poses, and how it can affect your house.

Most of the flooding that occurs in the United States is either riverine or ocean flooding, although flooding also occurs around lakes and ponds and in isolated areas where storm drainage systems are not adequate. Riverine flooding, as its name implies, occurs when rivers and streams overflow their banks (Figure 2-4). Riverine flood waters can move quite rapidly, as in a **flash flood**, or very slowly, as they often do where the land is gently sloping or flat. The primary causes of riverine flooding are rainfall and melting snow (and sometimes a combination of both). Water from rain and melting snow eventually finds its way into stream channels. When the amount of water being carried by a stream exceeds the capacity of the stream channel, it spreads out into the area along the stream, commonly referred to as the floodplain. Usually, the houses and other buildings at greatest risk from riverine flooding are those near the stream channel, where the depths and speed of flood waters are often greatest.

DEFINITION

A **flash flood** is a flood that rises and falls very quickly and usually is characterized by high flow velocities (see page 13). Flash floods often result from intense rainfall over a small area.

Figure 2-4
This house in Georgia was inundated by riverine flooding.

Ocean flooding, which is caused by **storm surge** and **wave action**, affects primarily coastal areas, especially those along the beachfront, but it can also affect areas around bays, and it can back up along rivers and streams that empty into bays. Ocean flooding is most dangerous, and causes the most severe damage, where large waves are driven inland by the wind (Figure 2-5). These wind-driven waves occur primarily along the open coast, where they can destroy houses, wash away protective dunes, and erode the soil, often so much that the ground surface is lowered several feet. But they can also move inland where the land is flat and there are no large dunes or other obstacles to break them. In these areas the level of damage can rival that along the open coast.

DEFINITION

Storm surge is the rise in the level of the ocean that results from the decrease in atmospheric pressure associated with hurricanes and other storms.

Wave action refers to the characteristics and effects of waves that move inland from an ocean, bay, or other large body of water. Large, fast-moving waves can cause extreme erosion and scour, and their impact on buildings can cause severe damage. During hurricanes and other high-wind events, storm surge and wind increase the destructiveness of waves and cause them to reach higher elevations and penetrate further inland.

Figure 2-5
The extreme impact of large, fast-moving waves, combined with the removal of supporting soil by erosion and scour, can have devastating effects on buildings exposed to ocean flooding. This house along the Gulf of Mexico shoreline was destroyed during Hurricane Opal.

Ocean flooding can also move inland into low-lying areas beyond the limit of wave action. The danger in these areas is primarily from inundation due to storm surge, but even here, fast-moving flood waters can **scour** away the soil around building foundations.

Another cause of flooding, which can affect houses outside identified floodplains, is the limited capacity of local drainage systems, including storm sewers, culverts, and drainage ditches and swales. These systems are usually designed to carry up to a specific amount of water, which is referred to as the "design capacity" of the system. When heavy rainfall over an area causes the design capacity of the system to be exceeded, water will begin to back up and fill low-lying areas near system inlets and along open ditches. Depending on the amount of rainfall and its **intensity**, the flood water may continue to rise and may eventually affect houses.

A similar problem occurs when drainage system inlets are plugged or obstructed by mud or other debris and when drainage system outlets are covered by water during riverine or coastal floods. In the latter situation, water can flow backwards in the system and reach areas that otherwise might not have flooded.

DEFINITION

Erosion is the removal of soil that lowers the ground surface across an area. **Scour** is the removal of soil around objects that obstruct flow, such as the foundation walls of houses and other buildings.

DEFINITION

Rainfall **intensity** refers to the amount of rain that falls during a given amount of time. It is usually expressed in inches of rainfall per hour. The higher the number of inches per hour, the greater the intensity.

How Flooding Can Damage Your House

To understand how flooding can damage your house, you need to know about six important flood characteristics: depth/elevation, flow velocity, frequency, rate of rise and rate of fall, duration, and debris load. Most of these characteristics apply to both riverine and ocean flooding, and they can vary – sometimes greatly – from one place to another. The flood conditions at a particular site, such as the location of your house, are determined largely by the combination of these characteristics. The following paragraphs explain these characteristics. The section *Federal, State and Local Regulations*, which you'll find later in this chapter, and Chapter 4 explain how you can find out about the flood conditions at your house.

Depth/Elevation of Flooding

The depth and elevation of flooding are so closely related that they can be viewed as a single characteristic for the purposes of this discussion. Flood depth is the height of the flood water above the surface of the ground or other feature at a specific point. Flood elevation is the height of the flood water above an established reference **datum**. The standard datums used by most Federal agencies and many State and local agencies are the National Geodetic Vertical Datum (NGVD) and the North American Vertical Datum (NAVD); however, other datums are in use. The use of other datums is important because elevations of the ground, flood waters, and other features cannot be meaningfully compared with one another unless they are based on the same datum.

When the elevation of the ground (or another surface such as the **lowest floor** of your house) and the elevation of the flood water are both based on the same datum, the flood depth at any point is equal to the flood elevation at that point minus the elevation of the ground (or other surface) at that point. Figure 2-6 illustrates this relationship. One more thing you should know: ground elevations are established by surveys; flood elevations may be calculated or they may be known from water marks left by past floods.

DEFINITION

An elevation **datum,** or **datum plane**, is an arbitrary surface that serves as a common reference for the elevations of points above or below it. Elevations are expressed in terms of feet, meters, or other units of measure and are identified as negative or positive depending on whether they are above or below the datum plane. Three common elevation datums are Mean Sea Level (MSL), NGVD, and NAVD.

DEFINITION

Under the National Flood Insurance Program, the **lowest floor** of a building is the floor of the lowest enclosed area within the building, including the basement. The only exception is an enclosed area below an elevated building, but only when the enclosed area is used solely for parking, storage, or building access. The elevation of the lowest floor can be very important in retrofitting, as you will see in later chapters.

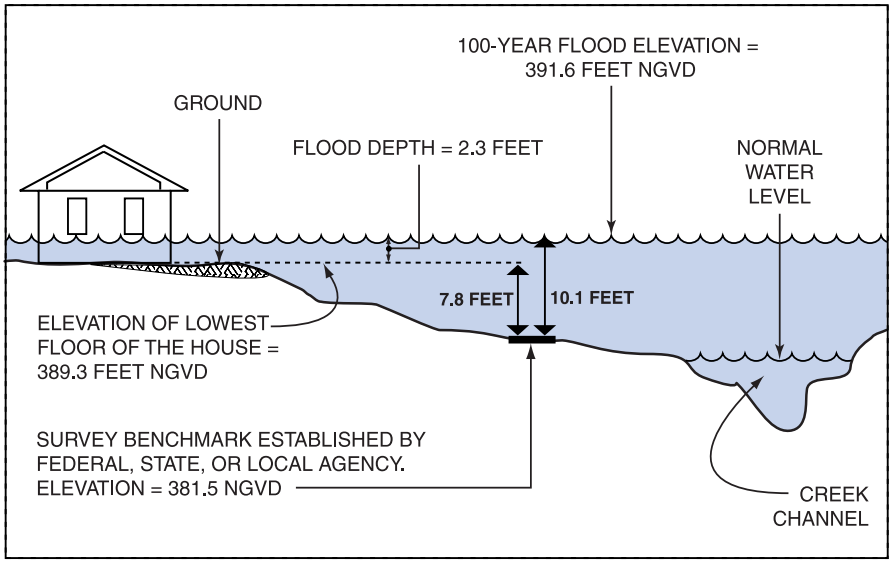

Figure 2-6
In this example, the 100-year flood elevation is 391.6 feet (10.1 feet above the benchmark elevation of 381.5 feet), and the elevation of the lowest floor of the house is 389.3 feet (7.8 feet above the same benchmark). The flood depth above the lowest floor is therefore equal to 391.6 feet - 389.3 feet, or 2.3 feet during the 100-year flood.

The depth of flooding at your house is important primarily because flood waters, even when they are not moving, exert pressure on structural components such as walls and concrete floor slabs. The pressure exerted by still water is called “hydrostatic pressure.” It is caused by the weight of the water, so it increases as the depth of the water increases. As shown in Figure 2-7, flood water, including water that has saturated the soil under the house, pushes in on walls and up on floors. The upward force on floors is called “buoyancy.”

As shown in Figure 2-7b, water that has saturated the soil poses a special hazard for basement walls. Because hydrostatic pressure increases with the depth of the water, the pressure on basement walls is greater than the pressure on the walls of the upper floor, as indicated by the arrows in the figure. This pressure is made even greater by the weight of the saturated soil that surrounds the basement.

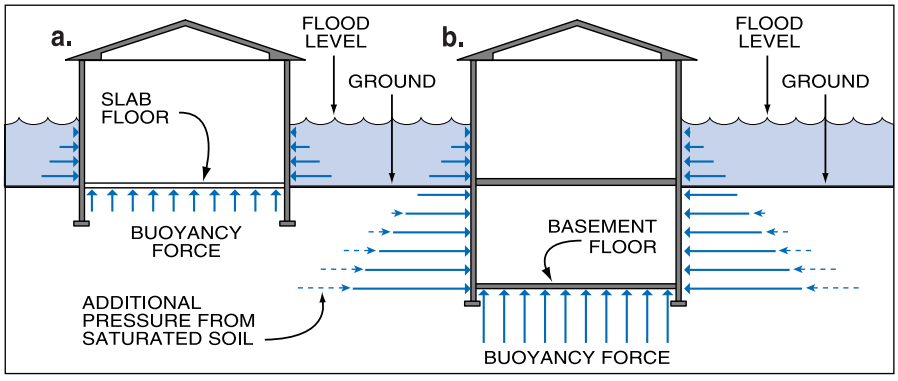

Figure 2-7
Hydrostatic pressure acts on walls and concrete slab floors. The weight of saturated soils adds to the pressure on basement walls. Figure 2-7a shows a house with a concrete slab floor. Figure 2-7b shows a house with a basement.

The walls of houses built according to standard construction practice are not designed to resist this pressure. Once the pressure exceeds the strength of the walls (including basement walls), it can push them in (see Figure 2-8), cause extensive structural damage, and possibly cause the house to collapse. In some areas, the buoyant force of hydrostatic pressure on basement floors has pushed entire houses out of the ground.

Figure 2-8
The walls of this basement in North Dakota failed because of the pressure exerted by water and saturated soil.

Note that in the preceding illustration of hydrostatic pressure, no water is shown inside the house. If water is allowed to enter, the hydrostatic pressures on both sides of the walls and floor become the same, or "equalized" (Figure 2-9), and the walls are much less likely to fail. As discussed in Chapters 3, 5, and 6, this is an important consideration in some types of retrofitting methods.

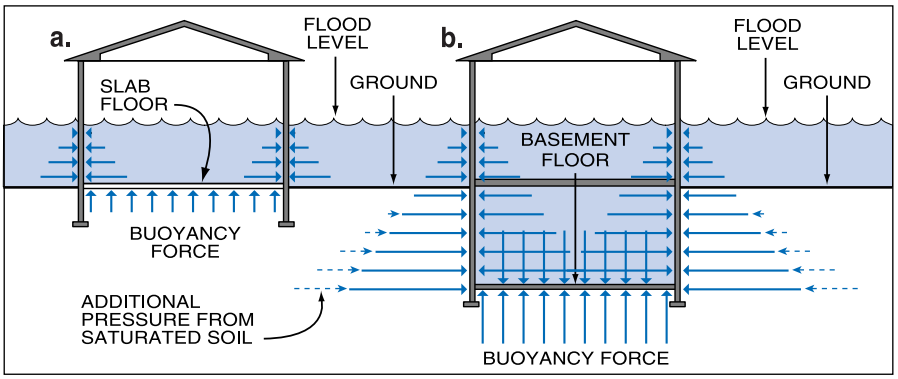

Figure 2-9
Once water enters the house, hydrostatic pressure is equalized. Figure 2-9a shows a house with a concrete slab floor. Figure 2-9b shows a house with a basement.

Flow Velocity

Flow velocity is the speed at which flood waters move. It is usually measured in feet per second, abbreviated as "fps." Flow velocities during riverine floods can easily reach 5 to 10 fps, and in some situations may be even greater. Expressing velocities in fps is common in floodplain studies and engineering analyses. Here, it may be helpful to relate fps to a more familiar unit of measure. For example, 10 fps is roughly equal to 7 miles per hour.

The velocity of riverine flood waters depends on a number of factors; one of the most important is the slope of the stream channel and floodplain. As you might expect, flood waters will generally move much faster along streams in steep mountainous areas than streams in flatter areas. Even within the same floodplain, however, flow velocity can still vary. As water flows over the ground, its velocity depends largely on the roughness of the ground surface. For example, water will flow more swiftly over parking lots, roads, and other paved surfaces and will flow more slowly over ground covered with large rocks, trees, dense vegetation, or other obstacles. Also, flow velocities in the floodplain will usually be higher nearer the stream channel than at the outermost fringes of the floodplain, where water may flow very slowly or not at all. In areas subject to ocean flooding, velocities depend largely on the speed of the wind and, like riverine flow velocities, on the slope and roughness of the ground surface.

If your house is in an area where flood waters are flowing, especially if they are moving more than about 5 fps, the flow velocity is important for several reasons. Flowing water pushes harder on the walls of a building than still water. So instead of just the hydrostatic pressure caused by the weight of the flood water resting against the walls of your house, you have the additional pressure of moving water, referred to as “hydrodynamic pressure” (Figure 2-10). As water flows around your house, it pushes against the side of the house that faces the flow (the upstream side). As it flows past the sides of the house, it creates friction that can tear at wall coverings, such as siding. On the side of the house that faces away from the flow (the downstream side) the water creates a suction that pulls on walls.

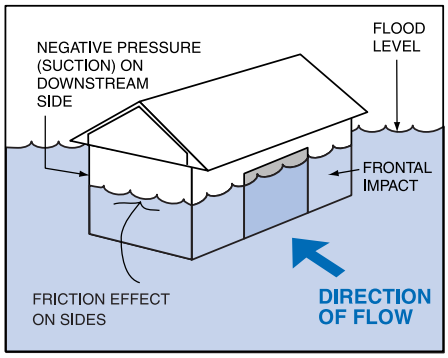

Figure 2-10
Moving water acts on the front, sides, and back of a house.

In some situations, the combination of these forces can destroy one or more walls (Figure 2-11), cause the house to shift on its foundation, or even sweep the house away.

Figure 2-11
Moving water can cause walls to collapse, as illustrated by this riverine flood damage in Georgia.

Flowing water can also cause erosion and scour. As discussed previously, erosion is the removal of soil that lowers the ground surface across an area. Scour is the removal of soil around objects that obstruct flow, such as foundation walls. Both erosion and scour can weaken the structure of a house by removing supporting soil and undermining the foundation. In general, the greater the flow velocity and the larger the house, the greater the extent and depth of erosion and scour. Also, keep in mind that any objects being carried by flood waters will be moving at roughly the same speed as the water. The dangers associated with these objects are discussed later, in the section *Debris Impact.*

Flood Frequency

You may have been told that your house is in the 100-year floodplain, or you may have heard that term used to describe a specific flood. You may also have heard similar terms used, such as 50-year flood or 500-year flood. These terms are occasionally used incorrectly and can be misleading. Flood frequencies are usually determined through statistical and engineering analyses performed by floodplain management agencies and other organizations who need information on which to base engineering designs and flood insurance rates. The

results of those analyses define the probability, expressed as a percentage, that a flood of a specific size on a specific stream will be equaled or exceeded in any year.

For example, the flood that has a 1-percent probability (1 in 100) of being equaled or exceeded in any year is referred to as the 100-year flood. This term is simply a convenient way to express probability. It should not be interpreted to mean a flood that happens exactly once every 100 years. Nor does it imply that once a 100-year flood occurs, there is little risk of another 100-year flood occurring in the near future. To the contrary, changes in climatic conditions, such as those caused by El Niño, often result in "clusters" of floods that occur over relatively short times at the same location.

For most homeowners, the value of these terms is that they indicate relative frequencies and sizes. On the average over a long period, a 100-year flood is expected to occur less often than a 50-year flood and more often than a 500-year flood. At the same point along the same flooding source, such as a river, ocean, or bay, a 100-year flood will be more severe than a 50-year flood and less severe than a 500-year flood. For example, if your house is in the 100-year floodplain of a nearby stream or river, the 100-year flood elevation at your house will probably be lower than the 500-year flood elevation, and the water from a 50-year flood might not even reach your house.

The 100-year flood is particularly important for homeowners because it is the basis of NFIP flood insurance rates and regulatory floodplain management requirements. These requirements are discussed in detail on pages 20 and 21. In the NFIP, the 100-year flood is referred to as the "base flood," the 100-year flood elevation as the "base flood elevation" (BFE), and the floodplain associated with the base flood as the Special Flood Hazard Area (SFHA). Other Federal agencies, such as the U. S. Army Corps of Engineers, use the 100-year flood for planning and engineering design, as do many State and local agencies. These agencies often have their own names for the 100-year flood.

Rate of Rise and Rate of Fall

You may not have heard these terms before, but they describe important characteristics of flooding: how rapidly the elevation (and therefore the depth) of water increases and decreases during a flood. These rates are usually expressed in terms of feet or inches per hour. Flood waters with high flow velocities, such as those in areas of steep

terrain, and water released by the failure of a dam or levee, usually rise and fall more rapidly than slower-moving floodwaters, such as those in more gently sloping floodplains.

Rate of rise is important because it affects how much warning you will have of an impending flood. For example, homeowners in the floodplains of large rivers like the Mississippi and Missouri may know days in advance that flooding is occurring upstream and will eventually reach their houses. But in the floodplains of streams with high rates of rise, homeowners may have only a few hours' notice of a coming flood or perhaps none at all. With adequate warning, you will be better prepared to take steps to protect yourself and your property. If the flood protection method you choose for your house depends partly on action you must take each time flooding threatens, warning time will be especially important. Chapters 3, 4, 6, and 7 discuss this issue further.

Rate of rise and rate of fall are important also because of their effect on hydrostatic pressure. As explained in the discussion of flood depth/elevation, hydrostatic pressure is most dangerous for a house when the internal and external pressures are not equalized. This situation occurs when the level of water inside the house is significantly higher or lower than the level outside. When flood waters rise rapidly, water may not be able to flow into a house quickly enough for the level in the house to rise as rapidly as the level outside. Conversely, when flood waters fall rapidly, water that has filled a house may not be able to flow out quickly enough, and the level inside will be higher than the level outside. In either situation, the unequalized hydrostatic pressures can cause serious structural damage, possibly to the extent where the house collapses.

Duration

Duration is how long a flood lasts. One of the meanings of duration is how long is takes for the creek, river, bay, or ocean to return to its normal level. As a homeowner, you may be more interested in how long flood waters remain in or around your house or perhaps how long they block nearby streets. In many floodplains, duration is related to rate of rise and rate of fall. Generally, water that rises and falls rapidly will recede more rapidly, and water that rises and falls slowly will recede more slowly. An example of this relationship is the extensive flooding that occurred in the broad, flat floodplains of the Midwest in 1993. In those areas, floodwaters rose slowly and remained high for many weeks or longer.

If your house is flooded, duration is important because it determines how long the structural members (such as the foundation, floor joists, and wall studs), interior finishes (such as drywall and paneling), service equipment (such as furnaces and hot water heaters), and building contents will be affected by flood waters. Long periods of inundation are more likely to cause damage than short periods. Duration can also determine how long your house remains uninhabitable.

Debris Impact

Flood waters can pick up and carry objects of all types – from small to large, from light to heavy – including trees, portions of flood-damaged buildings, automobiles, boats, storage tanks, mobile homes, and even entire houses. In cold climates, wintertime floods can also carry large pieces of ice. Dirt and other substances such as oil, gasoline, sewage, and various chemicals can also be carried by flood waters. All of these types of debris add to the dangers of flooding. Even when flow velocity is relatively low, large objects carried by flood waters can easily damage windows, doors, walls, and, more importantly, critical structural components of your house. As velocity increases, so does the danger of greater damage from debris. If flood waters carrying large amounts of dirt or hazardous substances enter your house, your cleanup costs are likely to be higher and your cleanup time greater.

As you read the remaining sections of this guide, keep these six flood characteristics and their effects in mind. The section titled *Federal, State, and Local Regulations* and Chapter 4 explain how you can find out more about flooding in your area, including flood elevations near your house.

Other Hazards

Two more hazards you should be aware of are high winds (including hurricanes) and earthquakes. For houses in areas subject to these hazards, some retrofitting methods are more appropriate than others. Chapters 3, 4, and 5 discuss this issue further. But regardless of the method you choose, if your house is in a high-wind or earthquake hazard area, your contractor or design professional must ensure that all structural changes made can withstand not only the expected flood forces but the expected forces of winds or earthquakes as well.

Wind is similar to flowing water in that it pushes against the side of the house that faces the wind and pulls on the side that faces away (Figure 2-12). Wind passing over a house can exert a lifting force on the house.

The combination of push, pull, and lift acts on the entire house, including the foundation, and can result in extensive damage if the structural system and **building envelope** are not adequately designed and constructed.

The ability of the wind to damage a building is increased if the wind or windborne debris breach the building envelope by breaking windows, collapsing doors, or puncturing walls. Once the envelope is breached, wind will enter the building and the pressure on the walls and roof will increase, as shown in Figure 2-12. Wind and flood forces can combine in different ways, depending on the directions of the wind and flood flow. When the wind and flood flow direction are the same, the load on the house is greater than the load from either wind or flood alone.

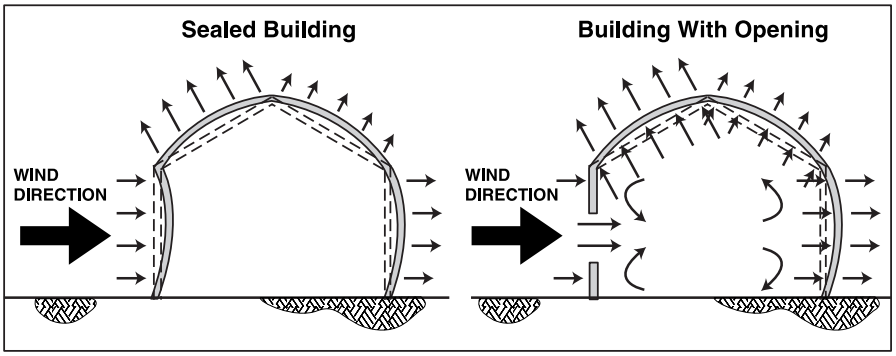

Figure 2-12
Wind forces on sealed building and building with opening.

The movement of the ground during an earthquake can place large horizontal and vertical loads on a house (Figure 2-13). Like the loads that result from flood flow and wind, earthquake loads can cause extensive damage to a house if they have not been accounted for in the structural design.

High-wind and earthquake hazards vary throughout the United

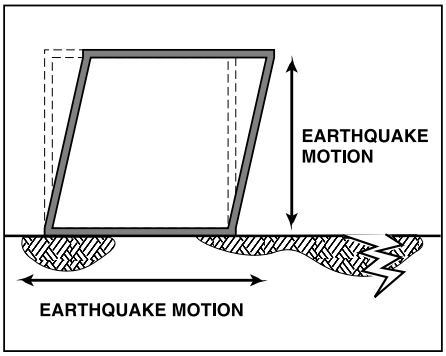

Figure 2-13
Earthquake forces act in both horizontal and vertical directions.

DEFINITION

The **building envelope** is the entire exterior surface of the building — including walls, doors, and windows – which encloses or envelopes the space within.

DEFINITION

Under the NFIP, damage to a building, regardless of the cause, is considered **substantial damage** if the cost of restoring the building to its before-damage condition would equal or exceed 50 percent of the market value of the structure before the damage occurred.

Similarly, an improvement of a building (such as reconstruction, rehabilitation, or an addition) is considered a **substantial improvement** if its cost equals or exceeds 50 percent of the market value of the building before the start of construction of the improvement.

For more information, consult your local officials or refer to the FEMA publication *Answers to Questions about Substantially Damaged Buildings,* FEMA 213.

States. In Chapter 4, you will find maps that show the areas where these hazards are greatest.

Federal, State, and Local Regulations

In most communities throughout the United States, construction in floodplains is governed by combinations of Federal, State, and local regulations. At the Federal level, the Federal Emergency Management Agency (FEMA) administers the NFIP. Congress created the NFIP in 1968 when it passed the National Flood Insurance Act. The NFIP is a voluntary program whose goal is to reduce the loss of life and the damage caused by flooding, to help the victims of floods, and to lower the costs of flood damage borne by the taxpayer. It does this by

- guiding future development away from flood hazard areas,
- requiring that new buildings, **substantially improved** buildings, and repaired **substantially damaged** buildings in the SFHA be constructed in compliance with floodplain management ordinances and laws intended to reduce flood damage,
- providing floodplain residents with financial assistance after floods, and
- transferring the cost of flood losses from the taxpayer to the owners of floodprone buildings by requiring the purchase of flood insurance for buildings in the SFHA.

The NFIP operates through a partnership between the Federal Government, the states, and individual communities such as counties and incorporated cities, towns, and villages. Participation in the NFIP is voluntary. In a participating community, affordable federally backed flood insurance is made available to property owners and renters. In return, the community adopts and enforces a floodplain management ordinance or law, which it uses to define a regulatory floodplain and then control development within that floodplain, including new construction, substantial improvement of existing buildings, and repair of substantially damaged buildings.

A participating community's floodplain management ordinance or law must, at a minimum, meet the requirements of the NFIP regulations, but each community is free to establish additional or more stringent requirements as it sees fit. For example, the regulatory floodplain defined by a community must include the entire SFHA, but it may also include other flood hazard areas within the community. Additionally, some states require communities to adopt and enforce floodplain management requirements that exceed the minimum requirements of the NFIP.

These points are particularly important because of their potential effect on your retrofitting project. In this guide, you will find many references to requirements imposed by your community's floodplain management ordinance or law. These are the minimum requirements that all communities must adopt and enforce in their floodplain management ordinances or laws to be compliant with the NFIP regulations. Remember that you must comply with your community's requirements, which may be more stringent.

Usually, communities enforce other requirements that affect construction, both inside and outside of the regulatory floodplain. These requirements include those associated with building codes and land use regulations, such as zoning and subdivision ordinances.

To provide communities with the information they need to enact and enforce floodplain management ordinances or laws, FEMA conducts floodplain studies for communities throughout the United States and publishes the results in *Flood Insurance Studies* (FISs) and *Flood Insurance Rate Maps* (FIRMs) (Figure 2-14). The FIS and FIRM for your community provide information about the names and locations of flooding sources, sizes and frequencies of past floods, limits of the SFHA and **floodway**, flood flow velocities, and elevations of the base flood throughout the SFHA. With this information, communities can manage floodplain development and FEMA's Federal Insurance Administration can establish accurate flood insurance rates.

Other Federal agencies, such as the U. S. Army Corps of Engineers, U. S. Geological Survey, and Natural Resources Conservation Service (formerly U. S. Soil Conservation Service), also publish flood information, as do some State and local agencies. This information is often useful as a supplement to FISs and FIRMs, but because it is developed to meet other needs, it is not used for the NFIP unless it has been reviewed and approved by FEMA.

If you have questions about flood hazards in your community, including the limits of the regulatory floodplain, flood elevations, or sizes and frequencies of past floods, check with your local officials. Usually, they will have copies of the FIS and FIRM for your community. They can also help you determine whether your house is in the regulatory floodplain and advise you about flood protection methods, including those described in this guide. Local officials can also advise you about floodplain management requirements, building codes, and other requirements that may determine the types of changes you can make to your house. See Chapter 4 for more

DEFINITION

The NFIP regulations do not prohibit development in the SFHA. Instead, they require that residential buildings in the SFHA be elevated to or above the BFE. But floodplain development can reduce the amount of space available to convey flood waters and increase flood elevations. So this development must be controlled. The **floodway** is the regulatory means of providing the required control.

The floodway is the portion of the SFHA that must be kept free of new development so that flood elevations will not increase. The floodway usually consists of the stream channel and land along either side. The flood hazard is usually greater in the floodway than in the surrounding areas of the SFHA, referred to as the "flood fringe."

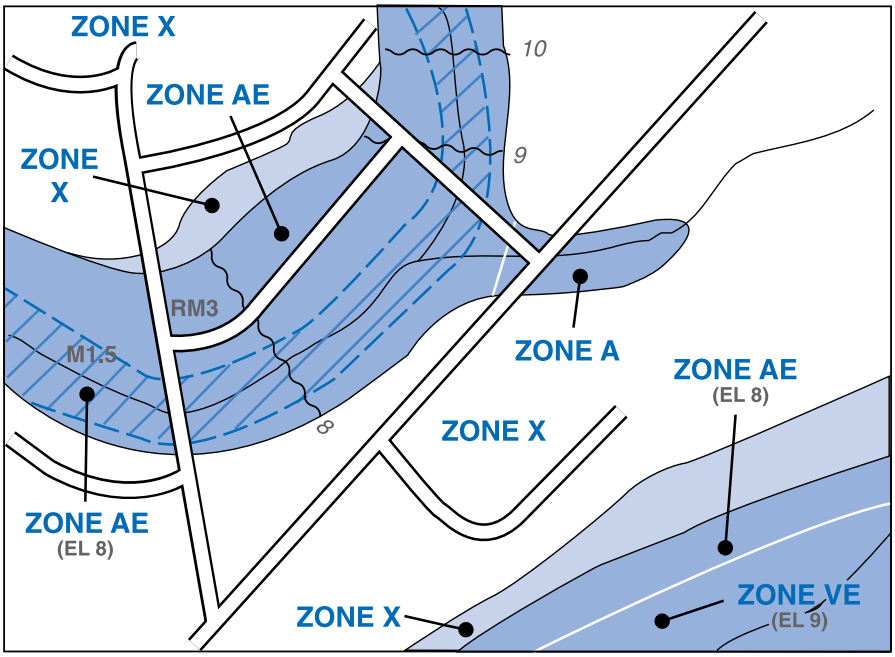

Figure 2-14
This portion of a FIRM shows the SFHA (dark tint), 500-year floodplain (light tint), floodway (hash-marked area between the dashed lines), BFEs (numbered wavy lines and/or numbers in parentheses), and the insurance rate zones (AE and A= SFHA, VE = Coastal High Hazard Area, and X = area outside SFHA).

information about working with local officials. You can also get help from your FEMA Regional Office (Appendix C) and the office of your State NFIP Coordinator (Appendix D).

Financial Assistance for Retrofitting

Federal Programs

FEMA and other Federal agencies have a wide array of financial assistance programs that help states, communities, and individual property owners mitigate the negative effects of flood hazards. You may be eligible to receive financial assistance through one or more of these programs that will help pay for your retrofitting project. Check with your local officials, your NFIP State Coordinator (Appendix D), or the FEMA Regional Office for your state (Appendix C).

If a Presidential declaration of a Major Disaster has been issued for your area, you may want to seek information from FEMA and the State and local government representatives supporting the post-disaster recovery of your community. Keep in mind, however, that the funding for these programs is limited and that often not everyone's needs can be met. Also, most of these programs provide grants to State and local governments, who must then set priorities for the use of the grant funds, including any potential use by individual property owners.

Help from FEMA

Increased Cost of Compliance

One of the benefits provided by the NFIP is Increased Cost of Compliance (ICC) coverage. If your house is covered by an NFIP Standard Flood Insurance Policy (SFIP) and has been declared by your community to be substantially damaged by a flood, ICC coverage may help pay for some types of retrofitting. ICC coverage applies to most SFIPs issued or renewed after June 1, 1997.

As noted earlier, your community's floodplain management ordinance or law includes requirements concerning construction in your community's regulatory floodplain. These requirements apply not only to new buildings, but also to existing buildings that have been substantially damaged or that are being substantially improved. If your house falls into one of the latter two categories, you will be required to do one of the following:

- Elevate your house so that its **lowest floor** is at or above the BFE. (See Chapters 3 and 5.)
- Move your house out of the regulatory floodplain. (See Chapters 3 and 7.)
- Wet floodproof the part of your house that is below the BFE. (This alternative is allowed only if the part of your house that is below the BFE is used solely for parking, storage, and building access and is not a **basement** as defined by the NFIP. (See Chapters 3 and 6.)

Remember, communities with more restrictive floodplain management ordinances or laws, may require a greater level of protection.

Although the substantial damage/substantial improvement requirement helps protect lives and property, it has at times placed an additional burden on property owners who were trying to repair their damaged houses. Under the original terms and conditions of the SFIP, the owner of a substantially damaged house was reimbursed for the costs of repairing the damage but not for the costs of complying with State and local requirements concerning substantially damaged structures. For example, the homeowner would not have been reimbursed for the cost of elevating the house, even though elevating was required by State or local ordinances or laws.

In 1997, to provide relief for the owners of houses substantially damaged by flooding, Congress authorized the inclusion of ICC

DEFINITION

Remember, under the NFIP, the **lowest floor** of a building is the floor of the lowest enclosed area within the building, including the basement. The only exception is an enclosed area below an elevated building, but only when the enclosed area is used solely for parking, storage, or building access.

DEFINITION

The NFIP regulations define a **basement** as "any area of the building having its floor subgrade on all sides." Note that the NFIP definition of basement does not include what is typically referred to as a "walkout-on-grade" basement, whose floor would be at or above the surface of the ground that touches the outside walls of the building on at least one side (see page 29). This ground surface is referred to as the "adjacent grade."

coverage in the SFIP. With this change in effect, the SFIP reimburses homeowners not only for the cost of repairing flood damage but also for the additional cost, up to a maximum amount stated in the SFIP, of meeting certain State and local floodplain management requirements concerning substantial damage and repetitive losses.

To learn more about ICC coverage, review your SFIP and contact your insurance agent, the FEMA Regional Office that serves your community (Appendix C), or the office of your NFIP State Coordinator (Appendix D). If a Presidential declaration of Major Disaster has been issued for your area, you can get help from the local Disaster Field Office (DFO).

Hazard Mitigation Grant Program

FEMA's Hazard Mitigation Grant Program (HMGP) provides grants to states for their use in conducting mitigation activities following a Presidential declaration of a Major Disaster. HMGP grants are awarded through a cost-sharing arrangement in which the Federal government provides a grant of up to 75 percent of eligible project costs. Therefore, a non-Federal contribution of at least 25 percent is required.

The amount of the total HMGP grant funds available after a Major Disaster is determined by the amount of damage caused by the disaster. A state receives the HMGP grant from FEMA and can then provide some or all of the grant funds to communities. Communities may in turn provide grant funds to individual homeowners for hazard mitigation retrofitting projects (including elevating houses) or use them to acquire badly damaged floodprone houses. HMGP grants may be made only for projects that have been determined to be cost-effective. States and communities often require individual property owners to provide all or part of the non-Federal contribution as a condition of receiving HMGP funds. In these instances, ICC funds (see preceding section) from a flood insurance claim may be applied towards the non-Federal contribution.

Flood Mitigation Assistance Program

FEMA's Flood Mitigation Assistance Program (FMAP) provides grants to states and communities that participate and are in good standing in the NFIP. FMAP grants are awarded annually; their availability is not linked to an area being affected by a disaster or flood. FMAP grants are available for both flood mitigation projects (including elevating floodprone houses and acquiring badly damaged floodprone houses) and the development of state- and community-based flood mitigation plans. Each state and community must have a

FEMA-approved flood hazard mitigation plan in place prior to receiving an FMAP project grant. These plans establish priorities for mitigation projects in the states and communities.

FMAP grants are awarded through a cost-sharing arrangement in which the Federal government provides a grant of up to 75 percent of eligible project costs. Therefore, a non-Federal contribution of at least 25 percent is required. FMAP funds are limited; the annual demand often exceeds the amount available. Also, there are limitations on the amount of grant funds that may be awarded in a given state or community. FMAP grants may only be made for projects that have been determined to be cost-effective.

States and communities often require individual property owners to provide all or part of the non-Federal contribution as a condition of receiving FMAP funds. In these instances, ICC funds from a flood insurance claim may be applied towards the non-Federal contribution.

NOTE

This section is not meant to be an all-inclusive description of Federal assistance. Following a Presidentially declared Major Disaster, State and local officials will be briefed on the available types of post-disaster assistance.

Help from Other Federal Agencies

Small Business Administration (SBA)

In areas declared a Major Disaster Area by the President, the SBA provides low-interest disaster assistance loans to individuals for both businesses and private residences. These loans cover the cost of rebuilding a damaged building, including the cost of bringing the building into compliance with applicable ordinances and laws. The loans can pay for retrofitting of substantially damaged buildings required by ordinances or laws (including elevating floodprone houses and rebuilding badly damaged floodprone houses at an alternative location), as well as some mitigation projects that are not required by ordinances or laws. At the applicant's request, the amount of the loan may be increased by up to 20 percent for hazard mitigation measures not required by the community's ordinances or laws.

Department of Housing and Urban Development (HUD)

In an area declared a Major Disaster Area by the President, HUD may provide additional, or allow for the reprogramming of existing, Community Development Block Grants. If a community wishes, these grants may be used for retrofitting substantially damaged houses or substandard housing (including elevating floodprone houses and acquiring badly damaged floodprone houses).

U. S. Army Corps of Engineers

The Corps has the statutory authority to participate in flood protection projects that may include residential retrofitting (including elevating

floodprone houses and acquiring badly damaged floodprone houses). Contact the appropriate Corps Division office for further information. You can find the address and telephone number in the blue pages (government listings) in your telephone directory.

Natural Resources Conservation Service (NRCS), U. S. Department of Agriculture

The NRCS has the statutory authority to participate in small watershed flood protection projects that may include residential retrofitting. Contact your local Conservationist for further information. You can find the address and telephone number in the blue pages (government listings) in your telephone directory.

Other Assistance Programs

Other Federal programs intended to protect and improve the environmental quality of floodplains may offer financial assistance.

Non-Federal Help

Programs Sponsored by State and Local Governments

States, local governments, and flood control and drainage districts sometimes develop financial assistance programs to promote flood hazard retrofitting projects. Ask your local officials whether such a program exists in your community.

Voluntary Organizations

After floods and other major disasters, voluntary organizations often offer their services to support the rebuilding of houses. Donated materials and labor sometimes become available that could be used to reduce the cost of a retrofitting project. Check with local officials, local service organizations, and houses of worship for information about such services.

Environmental Interest Organizations, Including Land Trusts and Nature Conservancies

Numerous non-government, non-profit, and quasi-public organizations are dedicated to enhancing the environmental benefits of floodplains. Sometimes these organizations provide funds that can be used in the restoration or protection of the natural beneficial value of the floodplain.