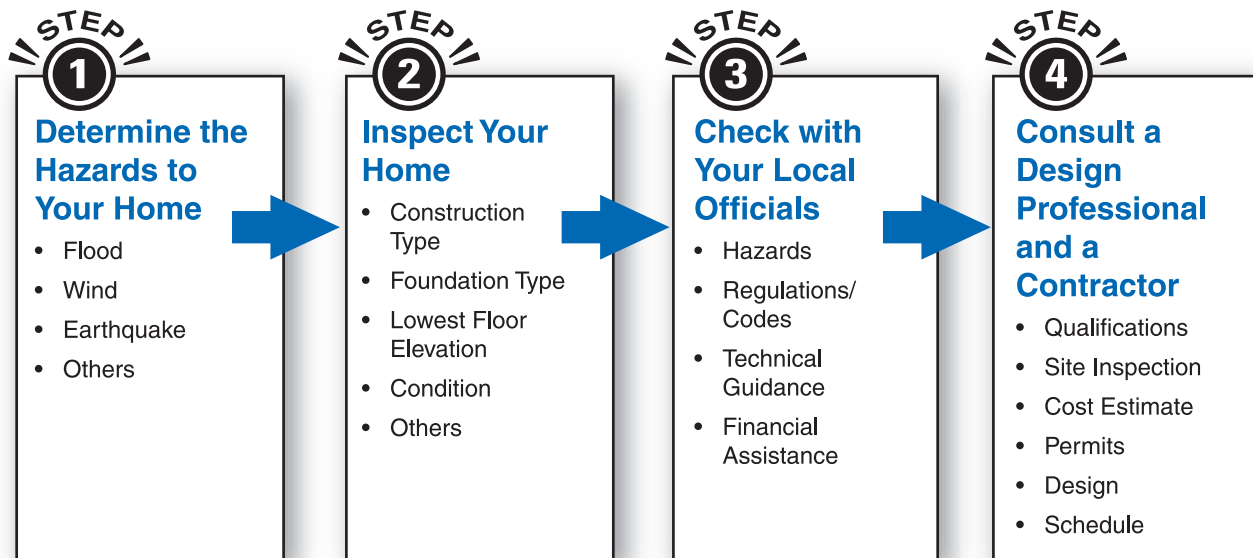




# 4.0 Deciding Which Method is Right for Your Home

With the information from Chapters 2 and 3, you are ready to decide which retrofitting method is right for your home. Your decision will be based primarily on hazards to your home, permit requirements, the technical limitations of the methods, and cost. Other considerations might include such things as the appearance of the home after retrofitting and any inconvenience resulting from retrofitting. Making a decision involves four steps:



The four steps are described in the next section. In Appendix G, you will find a retrofitting checklist that will help you work with local officials, design professionals, and retrofitting contractors. The checklist includes spaces where you can record the results of Steps 1 and 2, important questions you should ask, and decision-making matrices that will help you choose a retrofitting method. Before you go any further, you may want to make a copy of the checklist (see Appendix G) so that you can begin filling it out.

## 4.1 Making Your Decision

### 4.1.1 Step 1 – Determine the Hazards to Your Home

If you are using this guide, your home has probably been damaged by flooding or you know that it is in a flood hazard area. Refer to Section 2.3 for descriptions of each of the hazards in the checklist. Information about flooding and other hazards in your area is available from local officials, as discussed later in Step 3. But if your home has been flooded, review what you already know. Look at the Step 1 section of the checklist. Answer as many of the questions as you can. Local officials, design professionals, and contractors can use the information you provide, along with the flood hazard information developed by FEMA and other agencies and organizations, to advise you about your retrofitting options.

You also need to be aware of other hazards, such as high winds (Figure 4-1), earthquakes (Figure 4-2), fires, landslides, and **tsunamis**. If your home is in an area subject to one or more of these hazards, your retrofitting project should take the additional hazards into account. The foundation may need to be reinforced and the connections between the foundation, walls, and roof may need to be strengthened as part of the retrofitting project. Depending on the nature of the hazards and your choice of retrofitting methods, State and local regulations may require that additional changes be made to your home, beyond those necessary for flood protection. Your local officials can tell you if such requirements apply and can give you more information. General information for different hazards can be obtained as follows:

- Wildland fire: Wildland fire risk information is available from the U.S. Forest Service at <http://www.fs.fed.us/fire/>
- Tsunami: Tsunami hazard maps are available from the NOAA Center for Tsunami Research at <http://nctr.pmel.noaa.gov/time/resources/>



#### NOTE

The results of Steps 1 and 2 will help your local official to advise you and will also be useful when you consult a design professional or retrofitting contractor.



#### DEFINITION

A **tsunami** is a large, rapidly moving sea wave or series of waves produced by an undersea earth movement (earthquakes, crustal displacements, or landslides) or volcanic eruption.



#### NOTE

The retrofitting checklist provided in Appendix G references Figure 4-1 and Figure 4-2. If you are unable to interpret these maps, local officials and design professionals will be able to help you. Exposure to hazards quantified in Figure 4-1 and Figure 4-2 may limit the options available to safely retrofit your home.



#### WARNING

If you are retrofitting a home that is being Substantially Improved or has been Substantially Damaged, your community's floodplain management ordinance, regulation, or provisions of the building code will *not* allow you to have a basement, as defined by the NFIP, below the BFE. The NFIP regulations define a basement as "any area of the building having its floor subgrade on all sides." If your home has such a basement, you will be required to fill it in as part of any elevation project. See Section 2.3.1 for the NFIP definition of a basement.

- **Landslide:** Landslide risk information is available from the U.S. Geologic Survey at <http://landslides.usgs.gov/>

## 4.1.2 Step 2 – Inspect Your Home

The discussion in Chapter 3 may have prompted you to begin thinking about your home, specifically how it is constructed and the type of foundation it has. Before you check with your local officials or consult a design professional and contractor, you should inspect your home and fill out the section of the checklist for Step 2. Four characteristics of your home that are particularly important in retrofitting are construction type, foundation type, lowest floor elevation, and condition. (When you fill out the portion of the checklist concerning construction and foundation type, you may want to refer to the descriptions in Chapter 3.)

### Construction Type

As explained in Chapter 3, the construction type for most homes will be frame, masonry veneer, masonry, modular, manufactured, or a combination of two or more of these types. The following generalizations can be made about the effect of construction type on retrofitting:

- The most appropriate elevation technique for frame homes and manufactured homes usually is to elevate on extended foundation walls or open foundations.
- Masonry homes are frequently elevated by extending the walls of the home upward and raising the lowest floor or by abandoning the lowest floor and moving the living area to an existing or new upper floor.
- Frame homes, masonry veneer homes, and manufactured homes are easier to relocate than masonry homes.
- Masonry and masonry veneer homes are usually easier to dry floodproof than other types of homes, because masonry is a more flood damage-resistant material than the materials used in frame homes.

### Foundation Type

As explained in Chapter 3, most homes of the construction types listed above are built on a basement, crawlspace, slab-on-grade, or open foundation or on a combination of two or more of these types. The following generalizations can be made about the effect of foundation type on retrofitting:

- Homes on basement or crawlspace foundations are easier to elevate than slab-on-grade homes.
- Elevating homes on basement foundations normally involves elevating or relocating utility system components typically found in basements, such as furnaces and hot water heaters.
- Homes on basement foundations should not be dry floodproofed or protected by levees or floodwalls unless an engineering evaluation conducted by a design professional shows that it is safe to do so. This precaution is necessary because neither dry floodproofing nor the construction of levees or floodwalls prevents saturated soils from pressing on basement walls. This pressure, which is unequalized because water is not allowed to enter the basement, can damage basement walls or even cause them to fail.
- For some homes on basement foundations, an engineering evaluation is a necessary part of a wet floodproofing project. If the home is in an area where saturated soils begin to press on basement walls before water enters the basement, the unequalized pressure may damage walls or cause them to fail. If wet floodproofing is to be used in this situation, the engineering evaluation must show that the basement walls can resist the expected pressure.

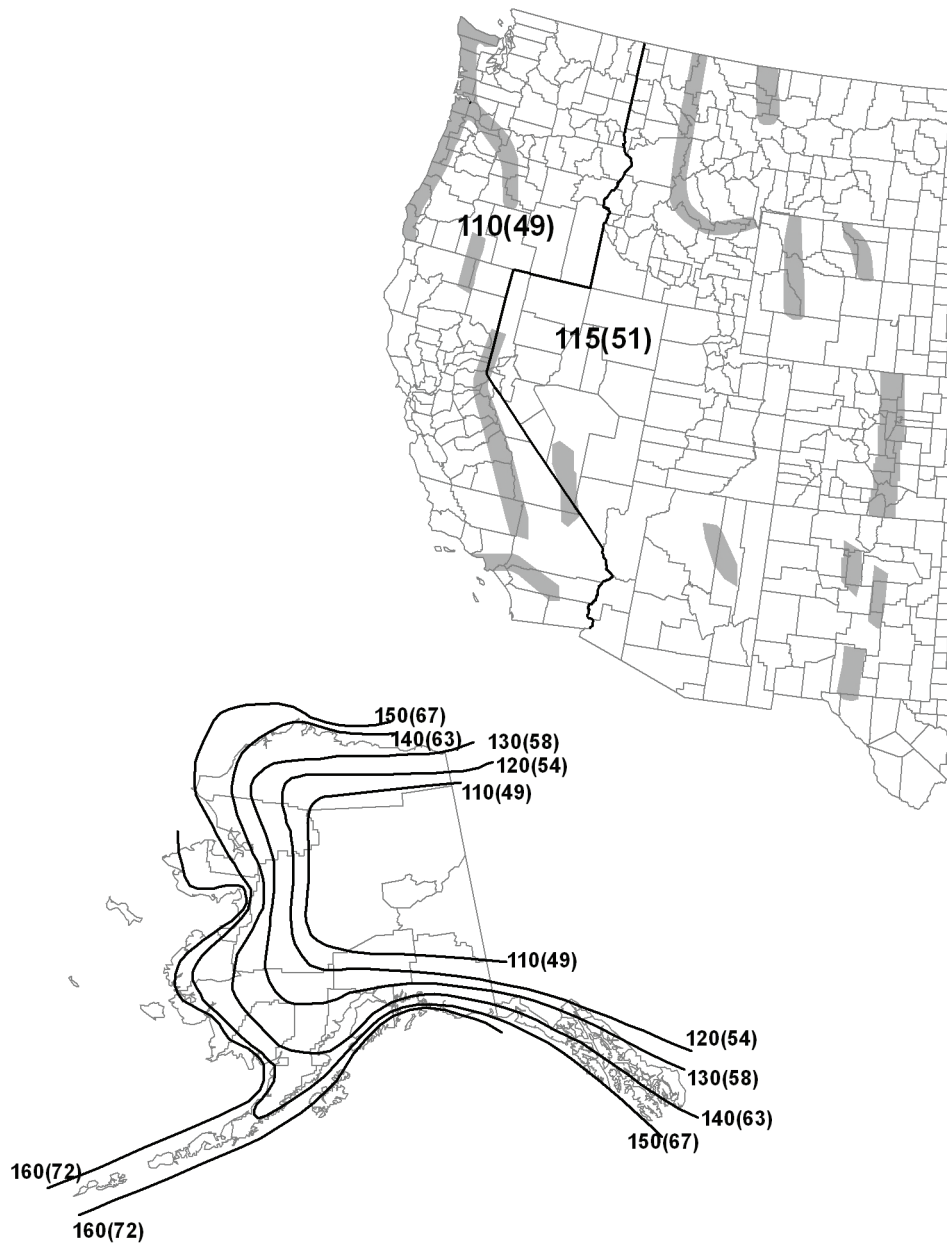
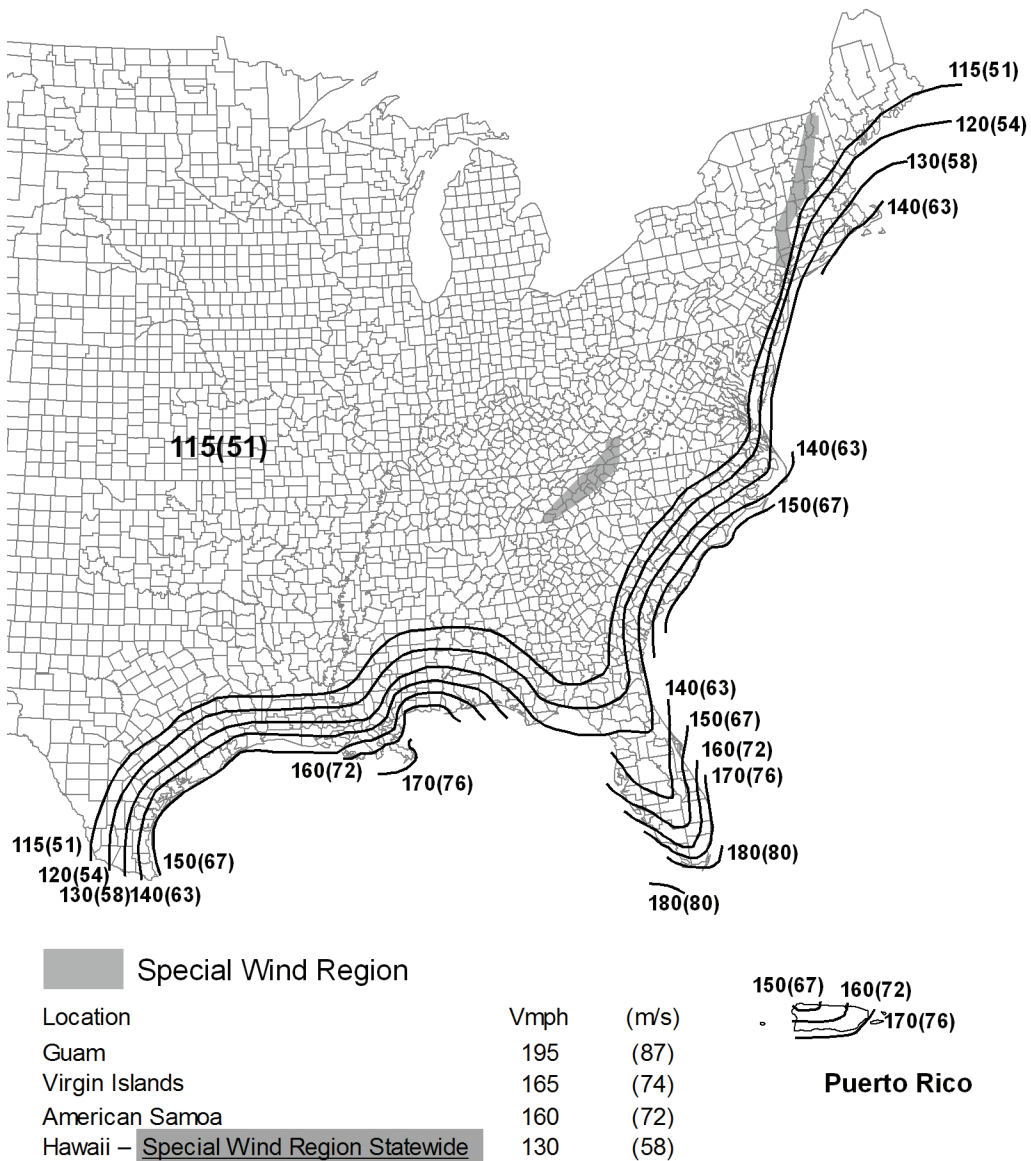


Figure 4-1. Peak gust wind speeds in the United States. Source: *Minimum Design Loads for Buildings and Other Structures*, ASCE/SEI 7-10. Used with permission from ASCE.



**Notes:**

1. Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 ft (10m) above ground for Exposure C category.
2. Linear interpolation between contours is permitted.
3. Islands and coastal areas outside the last contour shall use the last wind speed contour of the coastal area.
4. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.
5. Wind speeds correspond to approximately a 7% probability of exceedance in 50 years (Annual Exceedance Probability = 0.00143, MRI = 700 Years).

Figure 4-1 continued. Peak gust wind speeds in the United States. Source: *Minimum Design Loads for Buildings and Other Structures*, ASCE/SEI 7-10. Used with permission from ASCE.



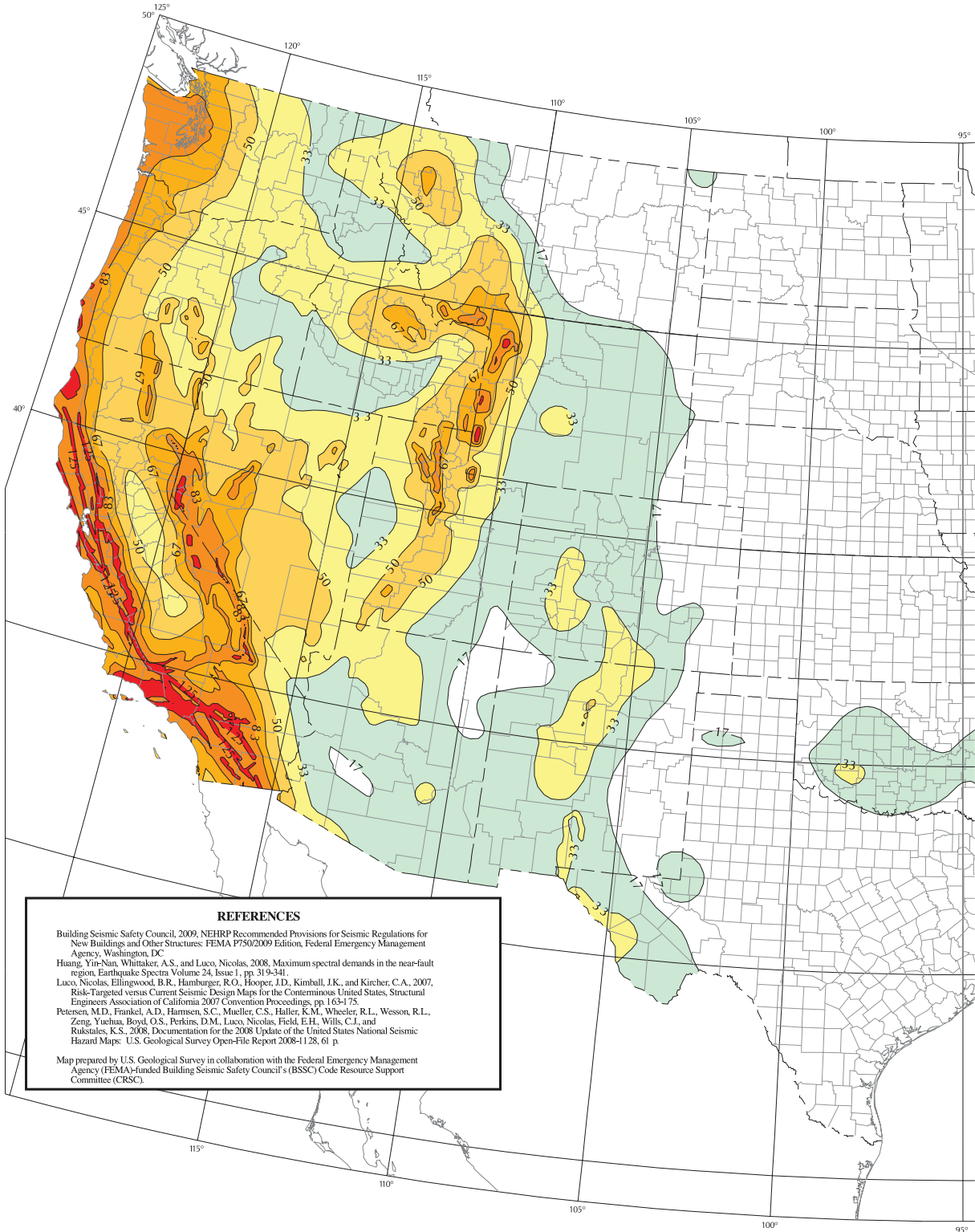


Figure 4-2. Seismic Design Categories Map of the United States for low-rise Occupancy Category I and II structures located on sites with average alluvial soil conditions. Map prepared by U.S. Geological Survey in collaboration with the Federal Emergency Management Agency (FEMA)-funded Building Seismic Safety Council's (BSSC) Code Resource Support Committee (CRSC).

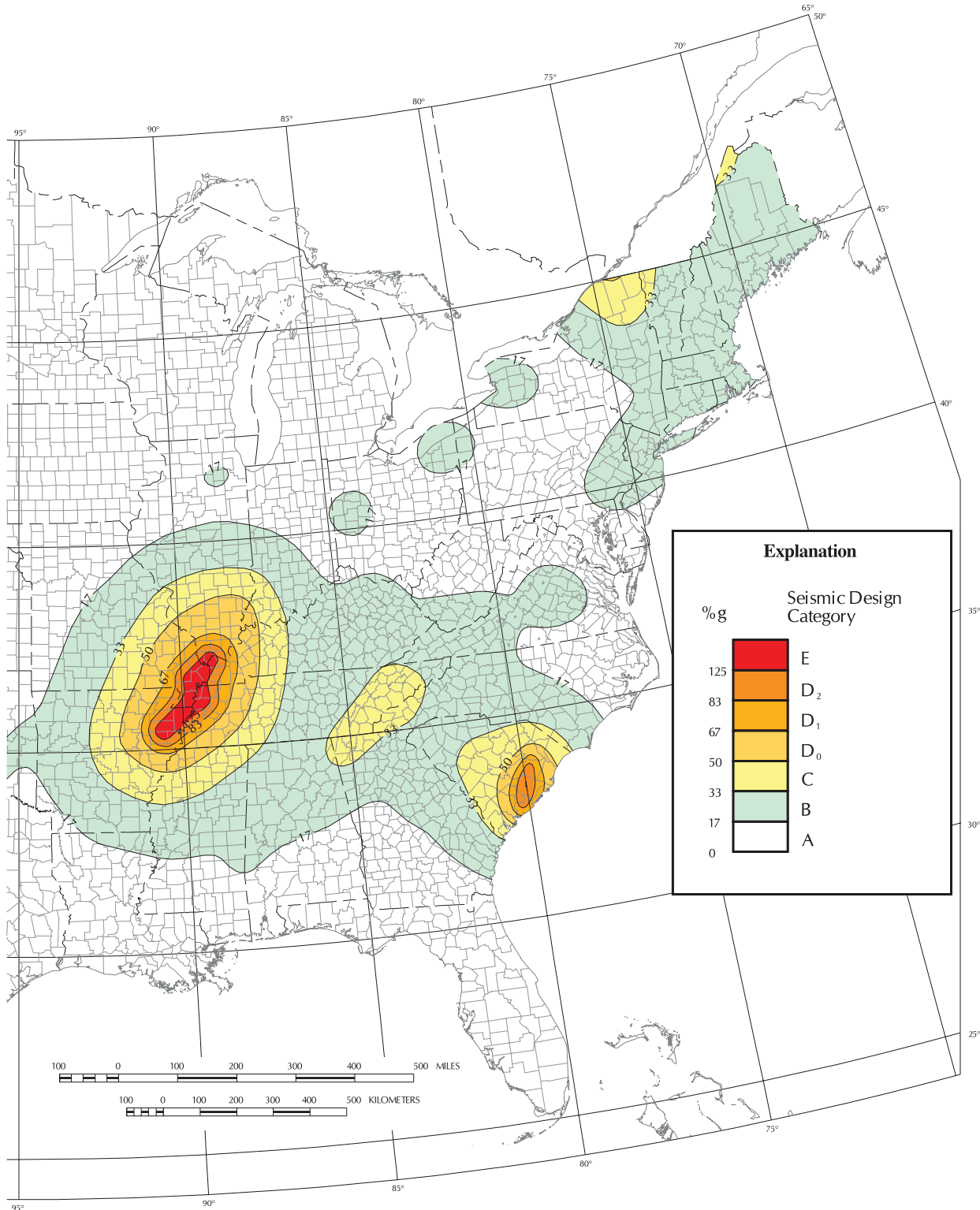


Figure 4-2 continued. Seismic Design Categories Map of the United States for low-rise Occupancy Category I and II structures located on sites with average alluvial soil conditions. Map prepared by U.S. Geological Survey in collaboration with the Federal Emergency Management Agency (FEMA)-funded Building Seismic Safety Council's (BSSC) Code Resource Support Committee (CRSC).

4 DECIDING WHICH METHOD IS RIGHT FOR YOUR HOME

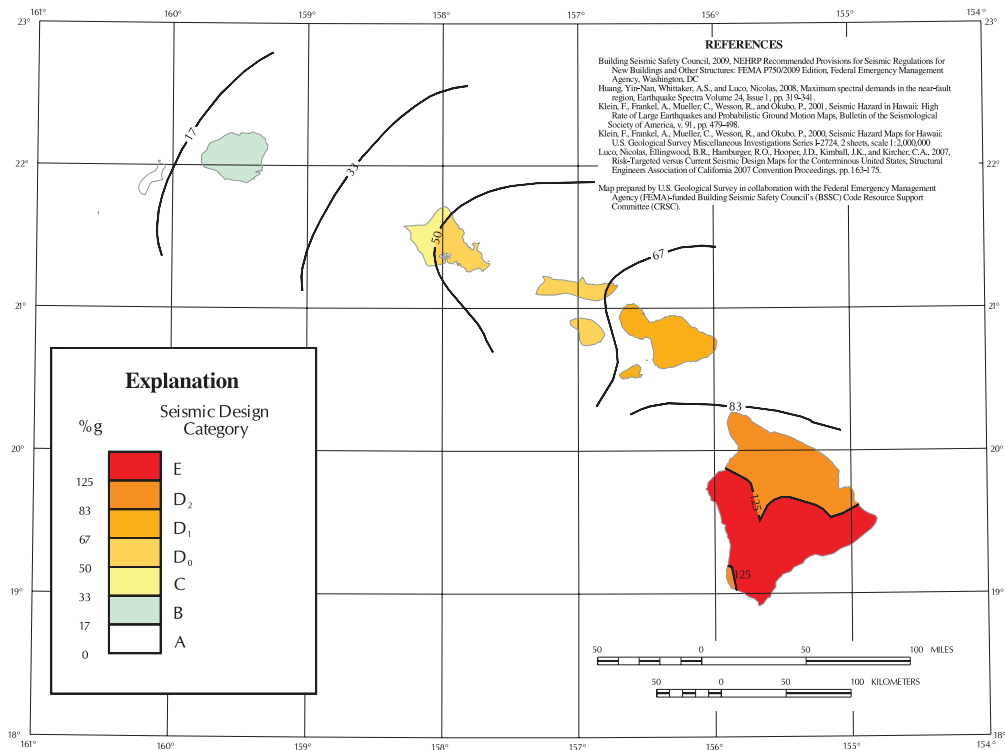
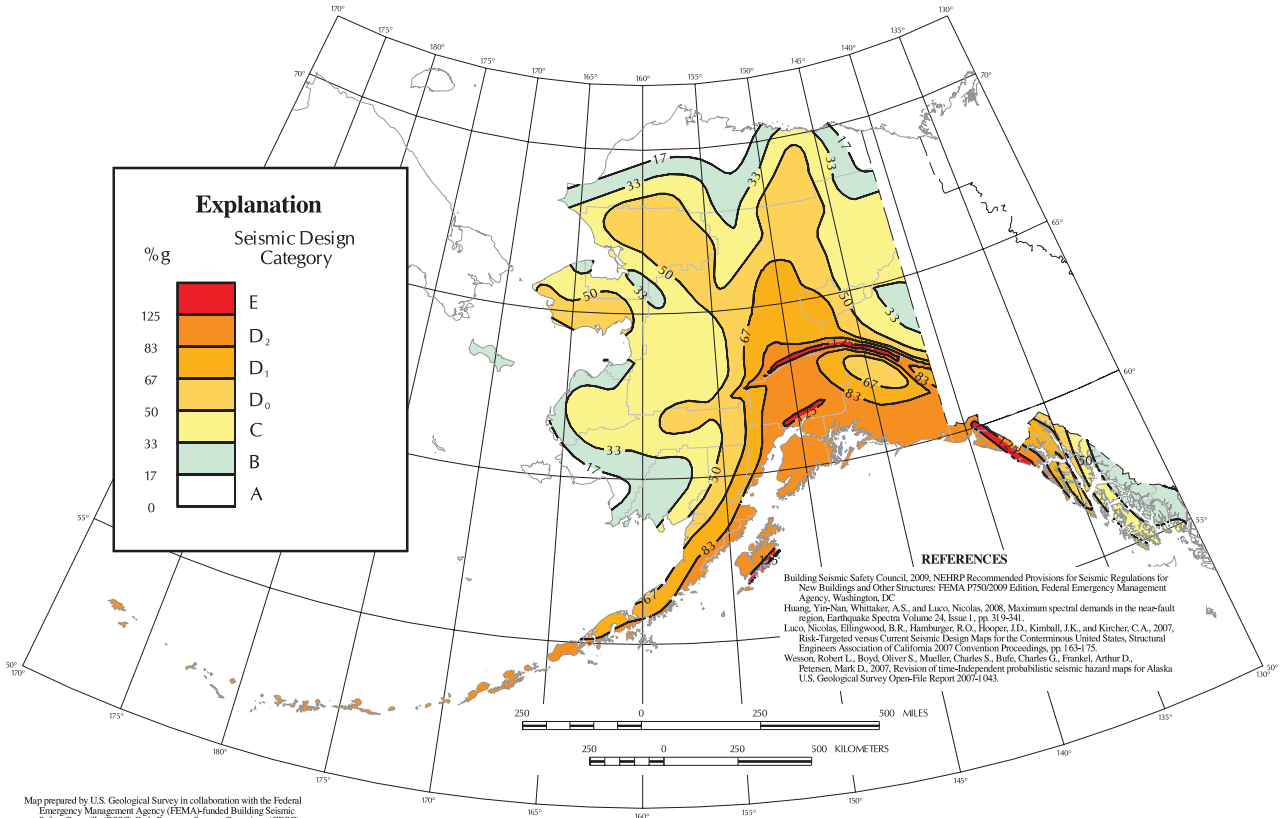


Figure 4-2 continued. Seismic Design Categories Map of the United States for low-rise Occupancy Category I and II structures located on sites with average alluvial soil conditions. Map prepared by U.S. Geological Survey in collaboration with the Federal Emergency Management Agency (FEMA)-funded Building Seismic Safety Council's (BSSC) Code Resource Support Committee (CRSC).



## Lowest Floor Elevation

As noted in Chapter 3, the “lowest floor” of your home, as defined by your community’s floodplain management ordinance, regulation, or provisions of the building code, is not necessarily the first or finished floor. For example, the lowest floor could be the floor of a basement or the floor of an attached garage. As shown in Figure 4-3, the location of your lowest floor can vary with foundation type. For homes that are to be elevated, wet floodproofed, or dry floodproofed, the difference between the elevation of the lowest floor and the DFE determines how high the home must be elevated or how high the wet or dry floodproofing protection must reach. In general, as the difference between the lowest floor elevation and the DFE increases, so does the cost of elevating, wet floodproofing, or dry floodproofing. This difference is particularly significant for dry floodproofing. As noted in Chapter 3, even masonry walls should not be dry floodproofed higher than 3 feet unless a structural evaluation by a design professional shows that it is safe to do so.

The elevation of your lowest floor can be established by a survey, which may be necessary as part of your retrofitting project. But even if you do not know your lowest floor elevation, you can estimate the difference between it and the flood protection elevation. Your conversations with your local officials, design professionals, and contractors will help you determine the level of flood protection you should provide. Remember, if your home is being Substantially Improved or has been Substantially Damaged according to your community’s floodplain management ordinance, regulation, or provisions of the building code, your flood protection elevation must be at least equal to the DFE. As explained in Step 3, your local officials can tell you about this requirement.

Elevation certificates are used to determine insurance premium rates under the NFIP. If your community participates in the NFIP, it must obtain the as-built elevation of the lowest floor for all new or Substantially Improved structures in SFHAs. Your community may use FEMA’s elevation certificates to keep track of lowest floor elevations for all of the new and Substantially Improved structures in flood zones. Communities that participate in the NFIP CRS are required to obtain and maintain elevation certificates.

If an elevation certificate already exists for your home, it will provide information about your specific property, including:

- Property information, including address, building use, and foundation information
- FIRM information, including panel number and BFE
- Building elevation information determined by a survey
- Certification by an engineer, architect, or surveyor
- Photographs of the building

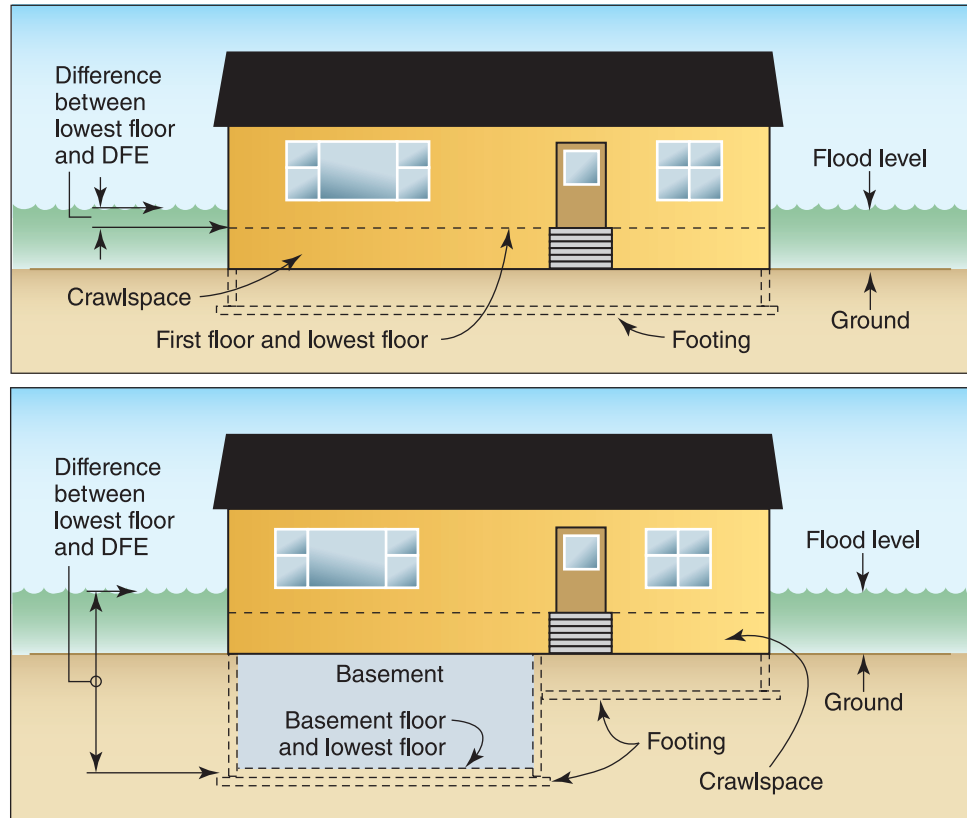
Elevation certificates must be completed by a land surveyor, engineer, or architect who is licensed in your State to perform surveys. Instructions on completing the elevation certificate and the form itself may be found on the FEMA Web site at <http://www.fema.gov/media-library/assets/documents/160>.



### NOTE

Occasionally, a small area is inadvertently shown to be within the SFHA on a FIRM, even though the ground is at or above the BFE. If this occurs, an individual property owner may submit survey information to FEMA and request that FEMA issue a document that officially removes a property from the SFHA, called a Letter of Map Amendment (LOMA).

Figure 4-3. Difference between flood level and lowest floor in homes on crawlspace and basement foundations.



### Condition

Your design professional or contractor should conduct a detailed inspection of your home before beginning any retrofitting work. You can help by first conducting your own assessment of the condition of your home and recording any information you have about past or current damage. This information may also be helpful to community officials who advise you about floodplain management and building code requirements and appropriate retrofitting methods.

If your home has been damaged by a flood, hurricane or other high-wind event, earthquake, fire, or other disaster, make a note of the extent of the damage, when it occurred, and whether it was repaired (the checklist provided in Appendix G can be used to list these damages). If repairs were made, make a note of who made them and describe what was done. Any structural damage and repairs to walls, floors, foundations, and roofs is particularly important. You should also describe any damage resulting from other causes, such as foundation settlement, dry rot, and termite damage. Your goal is to give your design professional and contractor as much information as possible so that they can determine how the condition of your home will affect your choice of a retrofitting method.

### Other Considerations

In addition to construction type, foundation type, lowest floor elevation, and condition, you should make note of interior and exterior service equipment that must be protected as part of



#### NOTE

A historic property is a resource (i.e., building, structure, site, object, or district) that is listed in or eligible for listing in the National Register of Historic Places or listed in a State or local inventory of historic places. For more information, visit your State's SHPO Web site (see Appendix E).

your retrofitting project. Interior service equipment must be protected if you elevate or wet floodproof your home. This equipment includes furnaces, heating and air conditioning ductwork, hot water heaters, large appliances, and electrical system components, such as service panels, outlets, and switches. Exterior service equipment must be protected if you elevate, wet floodproof, or dry floodproof and, in some situations, if you build a levee or floodwall. This equipment includes air conditioning and heat pump compressors and electric and gas meters.



#### NOTE

Elevation of electric and gas meters is typically controlled by the utility company.

In a home that is dry floodproofed, all openings below the DFE should be sealed. These openings may include doors and windows as well as openings for water pipes, gas and electric lines, dryer vents, and sump pump discharge pipes. In a home that is wet floodproofed, dry floodproofed, or protected by a levee or floodwall, backflow valves must be installed on all water and sewer lines with openings below the DFE. These valves prevent floodwaters and wastewaters from backing up into your home. Chapter 9 describes how to protect interior and exterior service equipment.

### 4.1.3 Step 3 – Check with Your Local Officials

This is a particularly important step. While you can obtain information from your FIS and your FIRM online (Chapter 2 discusses how to obtain FIRMs online), your local officials can help you to interpret that information. They will have hard copies of the FIS and FIRM published for your community by FEMA. Your officials will be able to tell you whether your home is in your community's regulatory floodplain and, if so, the BFE at the location of your home. They may also have information about flood conditions near your home, including flow velocity, the potential for wave action and debris flow, rates of rise and fall, warning time, and duration of inundation.



#### NOTE

Be sure to ask local officials about State or local freeboard requirements that may apply to your retrofitting project.

Local officials will inform you of Federal, State, and local regulations, codes, and other requirements that can determine what retrofitting methods you will be allowed to use and how changes can be made to your home. They can also tell you about Federal, State, and local programs that provide financial assistance for homeowner retrofitting projects, and they can help you determine whether you are eligible for such assistance. With the information you recorded in Steps 1 and 2, local officials may also be able to advise you about the most appropriate retrofitting method for your home. The officials you need to talk to will depend on how your community has assigned responsibilities for floodplain management and construction permitting. If you do not know who has these responsibilities in your community, you should begin with an official such as a city clerk, mayor, or county administrator.



#### NOTE

In addition to meeting the minimum requirements laid out in your local floodplain ordinance, any retrofit activities should comply with the current building code. Talk to your design professional about applicable codes and standards.

Remember that if your property is individually historic, potentially historic, or within the boundaries of a historic district and you are receiving Federal financial assistance for your retrofitting project, the Federal agency

providing the assistance must first satisfy Federal historic preservation compliance requirements. Your local officials may not be aware of these requirements if they do not normally deal with federally assisted projects. Should historic preservation compliance be triggered, the Federal agency will need to consult with your SHPO. Remember that any compliance review must be completed before retrofitting work is initiated or the Federal assistance could be jeopardized.

When you talk to your local officials, be sure to do the following:

- Bring this guide with you.
- Bring your completed retrofitting checklist.
- Discuss what you already know about your home and the hazards that affect it.
- Work through the points listed in the section of the checklist for Step 3.
- Ask any other questions you may have.
- Work through the decision-making matrix provided in Section 4.2 with the official. Use the matrix that applies to your situation: Substantial Improvement / Substantial Damage or NOT Substantial Improvement / NOT Substantial Damage.
- Take notes about everything you discuss.

Remember that your goal is to find out what you can legally do to retrofit your home, identify the requirements you must comply with throughout the retrofitting process, and eliminate retrofitting methods that cannot be applied to your home or do not meet your needs. You may find that the restrictions and requirements of Federal, State, and local regulations will eliminate some retrofitting methods from consideration. Ultimately, your decision will be based on technical limitations of the methods, cost, and other considerations, such as the effect that retrofitting will have on the appearance of your home. The decision-making matrices will help guide you through this process.

Your next step, whether you have chosen one method or are considering two or more, is to consult a properly licensed, bonded, and insured design professional and retrofitting contractor.







### 4.1.4 Step 4 – Consult a Design Professional and Retrofitting Contractor

To complete this step, you will need to know what types of services are required for your retrofitting project and how to evaluate and select design professionals and contractors.

You will probably need the services of a contractor regardless of the retrofitting method you select. The type of contractor you hire will depend on the method. You will likely also need to consult a design professional, such as an architect or a structural engineer. Alternatively, you can hire a general contractor who will arrange for all the necessary services, including those of a design professional. Table 4-1 shows the types of design professionals and contractors that may be required for each of the retrofitting methods.

Knowing the types of services required for your retrofitting project is important, but so is hiring a reputable and competent design professional and contractor.

Table 4-1. Requirements for Design Professional and Contractor Services

Method	Need for Design Professional and/or Contractor	Primary Services
<b>Elevation</b> 	<b>Design Professional</b>	Evaluating the condition, stability, and strength of the existing foundation to determine whether it can support the increased load of the elevated home, including any wind and seismic loads, or designing a new foundation
	<b>Contractor:</b> Home Elevation Contractor	Disconnecting utilities, jacking the home up, increasing the height of the foundation or building a new foundation, and connecting utilities
<b>Wet Floodproofing</b> 	<b>Design Professional</b>	Designing any necessary replacements of vulnerable structural materials and relocated utility systems
	<b>Contractor:</b> General Construction Contractor	Replacing vulnerable structural and finish materials below the DFE with flood damage-resistant materials, raising utilities and appliances to a location above the DFE, and installing openings required to allow the entry of floodwaters
<b>Relocation</b> 	<b>Design Professional</b>	Designing any new building, foundation, and site improvements that may be required, such as new utility systems
	<b>Contractor:</b> Home Moving Contractor	Jacking the home up, moving it to the new site, and installing it on the new foundation
	<b>Contractor:</b> General Construction Contractor	Preparing the new site (including grading, foundation construction, and utilities) and restoration of the old site (including demolition)
<b>Dry Floodproofing</b> 	<b>Design Professional</b>	For masonry walls to be dry floodproofed, evaluating the condition, stability, and strength of the existing walls to verify whether they can withstand the pressure from floodwaters at the DFE; designing or selecting flood shields for doors or other openings
	<b>Contractor:</b> General Construction Contractor	Applying waterproof sealants and membranes, installing flood shields over openings below the DFE, installing backflow valves in sewer and water lines, and, if necessary, bracing or modifying walls so that they can withstand the pressure from floodwaters at the DFE
<b>Levees and Floodwalls</b> 	<b>Design Professional</b>	Assessing the adequacy of soils at the site, preparing the engineering design to ensure that the levee or floodwall, including any closures required, will be structurally stable under the expected flood loads and will be able to resist erosion, scour, and seepage
	<b>Contractor:</b> General Construction Contractor	Constructing the levee or floodwall
<b>Mitigation Reconstruction</b> 	<b>Design Professional</b>	Designing any new building, foundation, and site improvements that may be required, such as new utility systems
	<b>Contractor:</b> Demolition Contractor	Disconnecting and capping utility lines, tearing down the damaged home, hauling away debris, and restoration of the site
	<b>Contractor:</b> General Construction Contractor	Building the new home on the restored site or new site; this contractor may also be able to do all demolition work

DFE = design flood elevation



If you have used a licensed design professional and a licensed contractor in the past and were satisfied with the work, you might consider using them again. Even if they do not provide the types of services you now need, they may be able to recommend someone who can. Otherwise, you can search online or contact the professional association that represents the types of specialists you are looking for. Appendix F contains a list of the addresses and telephone numbers of several of these associations. They can usually give you a list of members in your area who specialize in the type of work you need. Before you hire a design professional or a contractor, check with your local Better Business Bureau, consumer protection agency, or licensing authorities. These organizations can tell you whether there have been any complaints about the quality of the design professional's or contractor's past work, including whether the work was completed on time.

Next, you will need to meet with the design professional and contractor to discuss your project. At the meeting, be sure you do the following:

- Provide the information you collected in Steps 1, 2, and 3.
- Ask the questions listed on the retrofitting checklist located in Appendix G, as well as any others you may have.
- Verify that the design professional is licensed and registered in the State in which the work will be done.
- Verify that the contractor is licensed, bonded, and insured as required by State and local laws.
- Ask for proof of insurance. If the design professional or contractor does not have disability and worker's compensation insurance, you may be liable for accidents that occur on your property.
- Ask for references. Reputable design professionals and contractors should be willing to give you the names of previous customers. Call some of them and ask how satisfied they were with the work. Ask if they would hire the design professional or contractor again.
- If you are trying to decide between two or more retrofitting methods, discuss your preferences and ask for more information.

Any design professional or contractor you hire will need to conduct a site visit to inspect your home and determine how the work should be carried out. During the site visit, you should expect your design professional or contractor to assess the structural condition of your home and determine what changes will be required by the retrofitting method you choose. If you agree on a method and decide to proceed with the project, be sure to do the following:



### WARNING

Areas recovering from floods are often prime targets for less-than-honest business activities. Here are some pointers that can help you avoid problems:

*Check* with your local Better Business Bureau, consumer protection agency, or licensing authorities before you hire a contractor.

*Beware* of "special deals" offered after a disaster by contractors you don't know.

*Beware* of unknown contractors who offer to use your home as a "model home" for their work.

*Do not* sign any contract under pressure by a salesperson. Federal law requires a 3-day cooling-off period for unsolicited door-to-door sales of more than \$25.

*Beware* if you are asked to pay cash on the spot instead of with a check made out to the name of a business.

*Ask contractors for references.* A reputable contractor should be able to give you a list of past clients in your area who can comment on the quality of the contractor's work.

- Get a written, signed, and dated estimate. It should cover everything you expect to be done. (Some design professionals and contractors will charge a fee to prepare the estimate.)
- Get signed and stamped building plans that show details of the proposed retrofitting measure.
- Decide whether you, the design professional or contractor will obtain the necessary permits.
- Ask for a warranty or guarantee. Any warranty or guarantee from the design professional or contractor should be written into the contract. The contract should clearly state the terms of the warranty or guarantee, who is responsible for honoring it (such as a manufacturer or the contractor), and how long it will remain valid.
- Get a written contract. It should be complete and clearly state all work to be done, the estimated cost, the payment schedule, and the expected start and completion dates for the work.

Note that, if a project is funded by a FEMA HMA grant, starting construction prior to FEMA's approval or award of the grant can jeopardize grant funding.

## 4.2 Decision-Making Matrices

This section provides two matrices that can help you decide which retrofitting method will best meet your needs. If your home is either being Substantially Improved or has been Substantially Damaged, the NFIP regulations limit your choice of retrofitting methods to elevation, relocation, or demolition (Table 4-2). If your home is **NOT** being Substantially Improved or has **NOT** been Substantially Damaged, additional retrofitting methods may be considered, such as dry floodproofing, wet floodproofing, and construction of levees or floodwalls (Table 4-3).

**You may require guidance while using the matrix.** Local officials, design professionals, and contractors can help you evaluate factors you are unsure about, so take the matrix with you when meeting with them. This will be helpful to determine which methods are cost prohibitive or are not technically feasible.

After you have identified the appropriate matrix to use, identify any methods eliminated by regulations, ordinances, or laws established by State or other agencies and organizations. Also, you may have already decided that one or more methods will not meet your needs. Mark each eliminated method by placing an "X" in the box directly below the name of the method (on the line labeled "Prohibited by Federal, State, or Local Regulations or Eliminated by Homeowner"). An "X" in this row means that the method is eliminated and will not be considered further.

The next step is to evaluate the remaining methods. Your evaluation will be based on the factors listed on the left hand side of the matrix. The factors are explained below. For each evaluation factor under each method, discuss your concerns with your local official, design professional, and contractor. If your concerns cannot be resolved, place an "X" in the appropriate box. After you have worked through the entire matrix, add the number of "Xs" under each method and show the sum on the Total "Xs" line. Remember, each "X" is based on your preferences and the input of local officials, design professionals, and contractors. So, although not all factors are equally critical, the method with the lowest total "Xs" will probably best meet your needs.

### 4.2.1 Evaluation Factors

**Federal, State, and Local Restrictions** – Federal, State, and local regulations may restrict the homeowner's choice of retrofitting measures. Such regulations may include State and local building codes, floodplain management ordinance, regulation, or provisions of the building code, zoning ordinances, Federal regulations concerning the alteration of buildings classified as historic structures, deed restrictions, and the covenants of homeowners'

associations. The homeowner and the homeowner's design professional or contractor should check with community officials to determine whether any such restrictions apply.

**Appearance** – The final appearance of a home and property after retrofitting will depend largely on the retrofitting method used and the DFE. For example, elevating a home several feet will change its appearance much more than elevating only 1 or 2 feet, and wet floodproofing will change its appearance very little. However, a change in appearance will not necessarily be a change for the worse (see photographs in Chapter 3). The homeowner should discuss the potential effects of each method with local officials and with the design professional or contractor.

**Cost** – The cost of retrofitting will depend largely on the retrofitting method used and the flood protection elevation. For some methods, the construction type (frame, masonry, etc.) and foundation type (crawl space, slab, etc.) will also affect the cost. In general, costs will increase as the flood protection elevation increases, but there may be tradeoffs between alternative methods. For example, elevating may be less expensive than relocating when a home is raised only 1 or 2 feet, but may become more expensive at greater heights. Other costs include those for both routine and long-term maintenance and insurance premiums. Adding additional freeboard to an elevation project will generally increase the project's cost; however, the additional freeboard may produce significant savings on insurance premiums. The annual savings on insurance premiums may quickly return the investment required to add freeboard.




**Accessibility** – Accessibility refers to how easy or difficult it is to routinely reach and enter the home after the retrofitting project is completed. The retrofitting methods described in this guide affect accessibility in different ways. For example, elevating a home will usually require the addition of stairs, which may be unacceptable to some homeowners. In these cases, homeowners may have to consider installing small elevators or using an entirely different retrofit method. Levees and floodwalls can make access more difficult unless they are equipped with openings, which require human intervention (see below). Wet floodproofing will have little if any effect on accessibility. Dry floodproofing openings can be very expensive; often points of access are sealed off to control project costs. The effect of relocation on accessibility will depend on the location and configuration of the new site.

**Code-Required Upgrades** – State and local regulations may require that a retrofitted home be upgraded to meet current code requirements that were not in effect when the home was built. Portions of the electrical, plumbing, and HVAC systems could be affected. For example, the electrical panel might have to be upgraded from fuses to circuit breakers. These changes are required for the safety of the homeowner. Other code-required upgrades include those for increased energy efficiency. Any required upgrade can add to the scope and cost of the retrofitting project. The homeowner and the homeowner's design professional or contractor should check with community officials to determine whether such regulations apply.

**Human Intervention** – For retrofitting methods that require human intervention, homeowners must be willing, able, and prepared to take the necessary action, such as operating a closure mechanism in a floodwall or placing flood barriers across the doors of a dry floodproofed home. Also, the homeowner must always have adequate warning of a coming flood and must be at home or near enough to be able to reach the home and take the necessary action before floodwaters arrive. If these conditions cannot be met, retrofitting methods that require human intervention should be eliminated from consideration.

## 4.2.2 Substantial Improvement / Substantial Damage Matrix









Table 4-2. Retrofitting Methods for Substantially Improved or Substantially Damaged Homes

Retrofitting Methods Substantially Improved or Substantially Damaged Homes					
Evaluation Factors	Elevation <sup>1</sup>			Relocation	Demolition
	Elevation on Extended Foundation Walls 	Elevation on Open Foundation 	New Living Area over Abandoned First Floor 		
Prohibited by Federal, State, or Local Regulations or Eliminated by Homeowner					
Appearance					
Cost					
Accessibility					
Code-Required Upgrades					
Human Intervention					
Other					
<b>Total "Xs"</b>					

<sup>1</sup> Note that if you elevate a Substantially Improved or Substantially Damaged home, you can still wet floodproof an enclosed area under the home below the BFE, provided that: (1) the area is only used for parking, building access, and storage, (2) the area is designed to allow for automatic entry and exit of flood waters through the use of openings, and (3) the area is constructed with flood damage-resistant materials.

### 4.2.3 NOT Substantial Improvement / NOT Substantial Damage Matrix

Table 4-3. Retrofitting Methods for Homes That are NOT Substantially Improved or Damaged

Retrofitting Methods for Homes NOT Substantially Improved or Substantially Damaged								
Evaluation Factors	Elevation			Relocation	Dry Floodproofing	Wet Floodproofing	Levees or Floodwalls	Demolition
	Elevation on Extended Foundation Walls	Elevation on Open Foundation	New Living Area over Abandoned First Floor					
								
Prohibited by Federal, State, or Local Regulations or Eliminated by Homeowner								
Appearance								
Cost								
Accessibility								
Code-Required Upgrades								
Human Intervention								
Other								
Total "Xs"								