

Wet Floodproofing



Introduction

This guide describes two types of floodproofing: wet and dry. As its name implies, wet floodproofing allows flood waters to enter the enclosed areas of a house. In contrast, dry floodproofing (Chapter 7) prevents the entry of flood waters. The benefit of wet floodproofing is that if flood waters are allowed to enter the enclosed areas of the house and to quickly reach the same level as the flood waters outside, the effects of hydrostatic pressure, including buoyancy, are greatly reduced. As a result, the loads imposed on the house during a flood, and therefore the likelihood of structural damage, may be greatly reduced. Wet floodproofing is generally used to limit damages to enclosures below elevated buildings, walkout-on-grade basements, below-grade basements, crawlspaces, or attached garages. It is not practical for areas that are to be used as living space.

Successful wet floodproofing involves the following:

- ensuring that flood waters enter and exit the house
- ensuring that flood waters inside the house rise and fall at the same rate as flood waters outside
- protecting the areas of the house that are below the flood level from damage caused by contact with flood waters
- protecting **service equipment** inside and outside the house
- relocating any materials stored below the Flood Protection Elevation (FPE)

This chapter describes the modifications that must be made to a house as part of a wet floodproofing project, and it discusses the most important considerations regarding wet floodproofing. Protection of service equipment is discussed in Chapter 8.



WARNING

If your house has been substantially damaged or is being substantially improved, your community's floodplain management ordinance or law will restrict the use of wet floodproofing to attached garages and enclosed areas below the Base Flood Elevation (BFE) that are used solely for parking, storage, and access. For more information, refer to Federal Emergency Management Agency (FEMA) Technical Bulletin 7-93, *Wet Floodproofing Requirements for Structures Located in the Special Flood Hazard Area*.



DEFINITION

Service equipment includes utility systems, heating and cooling systems, and large appliances.



NOTE

Flood-resistant materials are discussed later in this chapter.



WARNING

If you are retrofitting a house that has been substantially damaged or is being substantially improved, your community’s floodplain management ordinance or law will **not** allow you to have a basement, as defined under the NFIP. The NFIP regulations define a basement as “any area of the building having its floor subgrade on all sides.” If your house has such a basement, you will be required to fill it in as part of any wet floodproofing project. 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 grade on at least one side.

Considerations

Flood Protection Elevation

All construction and finishing materials in the areas of the house that will be allowed to flood must be resistant to damage caused by direct, and possibly prolonged, contact with flood waters. Areas used for living space contain floor and wall coverings and other finishing materials, furniture, appliances, and other items that are easily damaged by flood waters and expensive to clean, repair, or replace. Therefore, wet floodproofing is practical only for portions of a house that are not used for living space, such as a basement as defined by the National Flood Insurance Program (NFIP) regulations, walkout-on-grade basement, crawlspace, or attached garage. As shown in Figure 6-1, the FPE (including freeboard) should be no higher than your lowest finished floor.

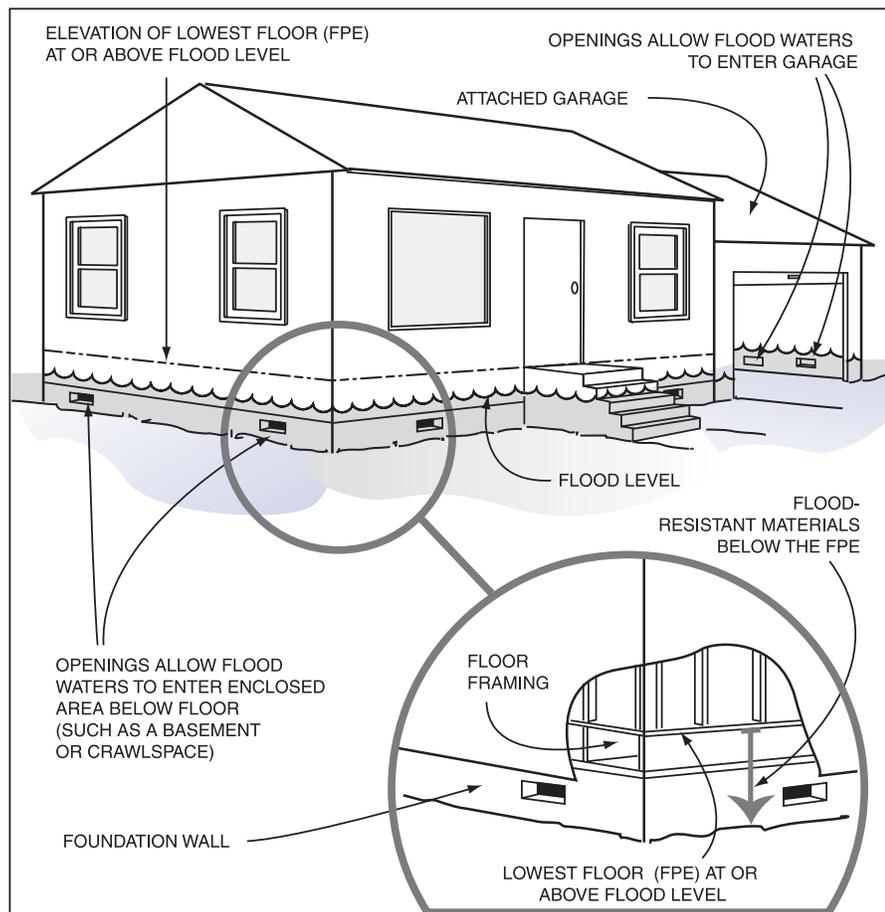


Figure 6-1
A typical wet floodproofed house that is compliant with the minimum requirements of a community’s floodplain management ordinance or law.

If your FPE is above the elevation of your lowest finished floor, you should consider one or more of the other retrofitting methods described in this guide, such as elevation (Chapter 5). If you read Chapter 5, you will note that most of the elevation methods incorporate the principles of wet floodproofing. They raise the living space above the flood level and allow flood waters to enter the areas of the house below the living space.

Hazards

Wet floodproofing protects a house from the effects of hydrostatic pressure but not from other flood hazards, such as the hydrodynamic force of flowing water, erosion and scour, the impact of ice and other floodborne debris, and damage from floodborne contaminants. If you have seen evidence of these hazards in past floods in your area, or if your community officials confirm that your house may be affected by these hazards, you should consider an alternative retrofitting method, such as relocation (see Chapter 7) or elevation on an open foundation (see Chapter 5). Wet floodproofing a house does not change its vulnerability to damage from high winds or earthquakes.

Post-Flood Cleanup

Remember that flood waters are rarely clean. They usually carry sediment, debris, and even corrosive or hazardous materials such as solvents, oil, sewage, pesticides, fertilizers, and other chemicals. Allowing areas of a house to flood exposes those areas to whatever is in the flood waters. Cleaning up a wet floodproofed house after a flood may therefore involve not only removing mud but also washing, disinfecting, and decontaminating walls, floors, and other surfaces. This is another good reason why wet floodproofing is inappropriate for areas used as living space and, in some circumstances, why it may be inappropriate for any part of a house.

Modifications Required for Wet Floodproofing

Wet floodproofing requires a variety of modifications to your house, including its walls, construction and finishing materials, and service equipment.

Installing Openings

The most important part of a wet floodproofing project is installing wall openings that will allow the entry and exit of flood waters. The openings must be installed in foundation walls and in garage walls as appropriate, below the expected flood level (see Figure 6-1). The goal is not simply to allow the entry and exit of flood waters but also to ensure that the water

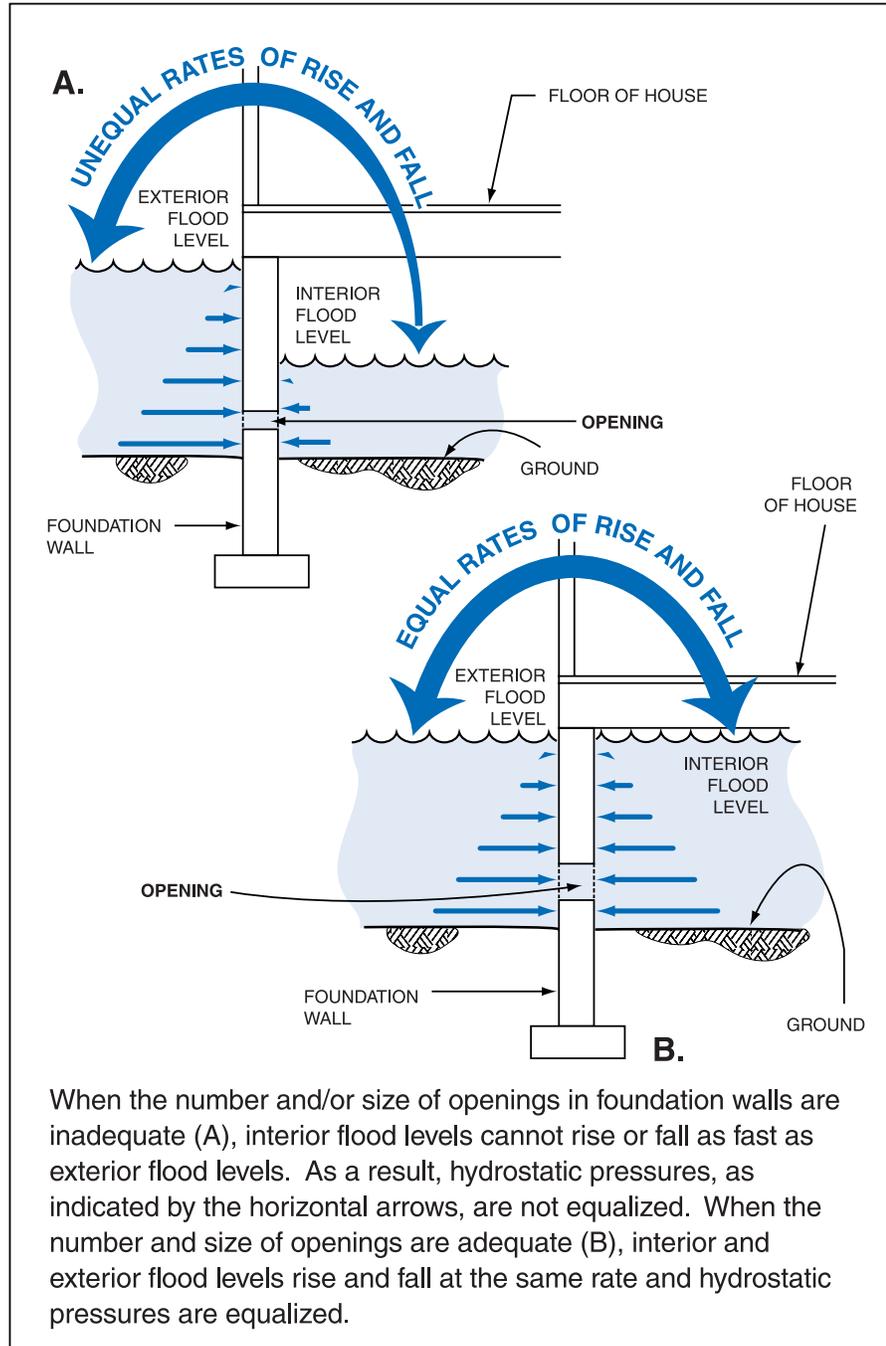


NOTE

For more information about openings requirements for wet floodproofing, refer to FEMA Technical Bulletin 1-93, *Openings in Foundation Walls for Buildings Located in Special Flood Hazard Areas*, and FEMA 259, *Engineering Principles and Practices for Retrofitting Flood Prone Residential Buildings*.

level inside the house rises and falls at roughly the same rate as the water level outside so that hydrostatic pressures inside and outside are continually equalized. As shown in Figure 6-2, large differences in the interior and exterior water levels allow unequalized hydrostatic pressures and therefore defeat the purpose of wet floodproofing.

Figure 6-2
Wall openings must allow flood waters not only to enter the house but also to rise and fall at the same rate as flood waters outside.



For equal water levels to be maintained, both the size and number of openings must be adequate. Otherwise, when flood waters are rising and falling, water will not be able to flow into or out of the house fast enough. The number of openings required and their size will depend on the rate of rise and the rate of fall of the flood waters (see Chapter 2) and on the size of the area that is being allowed to flood. In general, the faster the rates of rise and fall and the larger the flooded area within the house, the larger the number and size of openings required.

If you are wet floodproofing areas below the BFE in a substantially damaged or substantially improved house, your community's floodplain management ordinance or law will require you to install openings in the exterior walls of all enclosed areas below the BFE. The minimum requirements are as follows:

- You must provide at least two wall openings for each enclosed area -- one in each of two different walls. In other words, you cannot put both openings in the same wall.
- If your house has more than one enclosed area, you must install openings in the exterior walls of each enclosed area so that flood waters can enter directly from the outside.
- The total area (size) of all openings for each enclosed area must be equal to at least 1 square inch for every square foot of floor space in the enclosed area. For example, if the enclosed area is 25 feet by 40 feet (1,000 square feet), the total area of the openings must be at least 1,000 square inches, or roughly 7 square feet. In this example, you could meet the size requirement by providing two 3 1/2-square-foot openings or several smaller openings whose total area equals 7 square feet.
- The bottom of each opening must be no higher than 1 foot above the ground directly below the opening.
- Flood waters must be able to flow in and out of enclosed areas automatically. If you place louvers, screens, or other types of covers over the openings (which many homeowners do to prevent animals from entering the enclosed areas) they must not block the flow of water. Because the need for human intervention reduces the reliability of wet floodproofing, you may not install any type of electrically, mechanically, or manually operated cover.

FEMA developed these requirements to provide homeowners with a straightforward means of determining where and how to install wall openings without the aid of an engineer or design professional. The

**NOTE**

If you cover wall openings with louvers or screens, keep in mind that the more restrictive they are the more likely they are to become clogged with debris during floods and to prevent the flow of water. Make sure that any screens or louvers you use will allow the passage of water that contains suspended sediment and other small debris. After flood waters have receded, screens and louvers must be cleaned of any other debris that may have accumulated.

requirements provide a margin of safety for wet floodproofed houses subject to flooding with rates of rise and fall as high as 5 feet per hour. If you wish to install openings that do not meet one or more of the requirements listed above, your design must be certified by a registered engineer or other licensed design professional and approved by your local officials. See FEMA's Technical Bulletin 1-93, *Openings in Foundation Walls for Buildings Located in Special Flood Hazard Areas*, for more information about openings requirements.



NOTE

For more information about flood-resistant materials, refer to FEMA Technical Bulletin 2-93, *Flood-Resistant Materials Requirements for Buildings Located in Special Flood Hazard Areas*. This bulletin includes a detailed list of common floor, wall, and ceiling materials categorized according to their applicability for use in areas subject to inundation by flood waters.

Using Flood-Resistant Materials

In the areas below the FPE, any construction and finishing materials that could be damaged by flood waters must be either removed or replaced with flood-resistant materials as required by your community's floodplain management ordinance or law. Vulnerable materials include drywall, blown-in and fiberglass batt insulation, carpeting, and non pressure-treated wood and plywood. Flood-resistant materials are those that can be inundated by flood waters with little or no damage. They include such materials as concrete, stone, masonry block, ceramic and clay tile, pressure-treated and naturally decay-resistant lumber, epoxy paints, and metal. In addition to resisting damage from flood waters, these materials are relatively easy to clean after flood waters have receded.

Protecting Service Equipment

When you wet floodproof a house, you must also protect the service equipment below the FPE, both inside and outside the house as required by your community's floodplain management ordinance or law. Service equipment includes utility lines, heating ventilation and cooling equipment, ductwork, hot water heaters, and large appliances. Chapter 8 describes a variety of methods you can use to protect interior and exterior service equipment.