



Mitigation for Homeowners

Mitigation is the effort to reduce the loss of life and property by lessening the impact of disasters. Stated plainly, mitigation can keep natural hazards, like flooding and hurricanes, from having catastrophic impacts.

Mitigation reduces a property's risk to future events and allows residents to return home more quickly, with less damage, after an event. While it may involve a larger initial investment, mitigation pays off in the long run. In fact, estimates indicate that on average, for every \$1 spent on mitigation, \$4 are saved from future losses.

Mitigation Options for Homeowners

There are a wide range of options for protecting your home from flood and wind events through mitigation. Be sure to consult with a licensed contractor and the local building department before making any structural changes to understand requirements and obtain any necessary permits.

Flood Mitigation Options

- Anywhere it rains, it can flood. Protect your investment in your home by purchasing flood insurance, even if you do not live in a high-risk flood zone.
- Elevate your home's lowest floor above the Base Flood Elevation (BFE). Elevating can lower flood insurance premiums and reduce the risk from increased future flood levels.
- Elevate or floodproof HVAC and/or mechanical units, ductwork, electrical systems, and other utilities above the BFE to protect against flood damage and reduce repair costs.
- Install flood vents in foundation walls, garages, and other enclosed areas. Flood vents reduce flood damage by allowing water to flow through and drain out.
- Use flood-resistant materials in areas of your home below the BFE, like replacing carpeting with tiles or using flood-resistant insulation and gypsum wallboard (Sheetrock), to prevent water from doing major damage.
- Anchor any fuel tanks to the floor and make sure vents and fill line openings are above the BFE (this may require permission from your fuel provider). A fuel tank can tip over or float in a flood, spilling fuel and becoming a fire hazard.
- Install a backflow valve on your sewer system to prevent sewage back up in your home.
- Add waterproof veneer to exterior walls to prevent shallow flooding from damaging your home. Seal your basement walls with waterproofing compounds.

Wind Mitigation Options

- Install hurricane shutters to protect windows and glass doors.

Before you mitigate, know your risk

Before you mitigate, you need to know what you are protecting your property from. Your local floodplain manager and emergency manager can give you information on the wind and water hazards possible in your community.

In addition, flood mitigation projects are usually benchmarked against the Base Flood Elevation (BFE) for your area. The BFE is the level floodwater is expected to reach during a flood event that has a one-in-100 chance of occurring in any given year. The BFE is shown on the Flood Insurance Rate Map (FIRM) and in the Flood Insurance Study. To find your BFE, talk to your floodplain manager.

- Gable end roofs are more susceptible to high wind than other roof types. If you have a gable end roof, add bracings to reinforce the roof.
- Consider fastening the roof to the walls with hurricane straps.
- Reinforce garage doors and double-entry doors to prevent failure under wind pressure. Garage doors can be reinforced with girts and by strengthening the glider wheel tracks. Double-entry doors can be reinforced with a heavy-duty dead bolt, adding slide bolts on one of the doors, and using longer hinge attachments on the door and frame.
- Maintain your property. Anything from loose shingles to trees can become a windborne missile. The distance between your home and any tree should be greater than a full-grown tree's height.

General Protective Measures

Mitigation reduces or eliminates future losses, but you should also consider other measures to protect your family, your valuables, and your peace of mind.

- Have a go-kit and make an emergency plan. Instructions and templates are available from [Ready.gov](https://www.ready.gov). Familiarize yourself with local emergency and evacuation plans.
- Consider purchasing a generator for your home that automatically turns on when the power goes out. If you install one, elevate it above the BFE.
- Store important documents and sentimental items like photographs above the BFE (preferably on an upper floor). Make copies of your photos and store them in more than one location.

Mitigation Requirements for Homeowners

If your local community official determines your home to be substantially or repetitively damaged by flood, you may be required to bring the structure into compliance with the community's local floodplain management ordinance. If that's the case, you may be able to utilize up to \$30,000 if you have a flood insurance policy issued through the National Flood Insurance Program (NFIP) which offers a coverage called Increased Cost of Compliance (ICC). ICC provides financial assistance to eligible policyholders to offset the costs to mitigate structures relatively faster than without having flood insurance. For more information, talk to your insurance agent.

Interested in learning more about how to mitigate?

FEMA produces mitigation guidance for communities, businesses, and homeowners, including:

- [Building Science Publications: Flood and Wind](#)
- [Protecting Your Home and Property From Flood Damage](#) (also available in Spanish)
- [Homeowner's Guide to Retrofitting](#)
- [Mitigation's Value to Your Community Fact Sheet](#)

FEMA also provides grant funding for certain kinds of mitigation projects under the [Hazard Mitigation Assistance](#) Program. This funding must be accessed via your local government. Contact your local emergency management agency for more information.

"FEMA's mission is to support our citizens and first responders to ensure that as a nation we work together to build, sustain, and improve our capability to prepare for, protect against, respond to, recover from, and mitigate all hazards."

Raise Electrical System Components

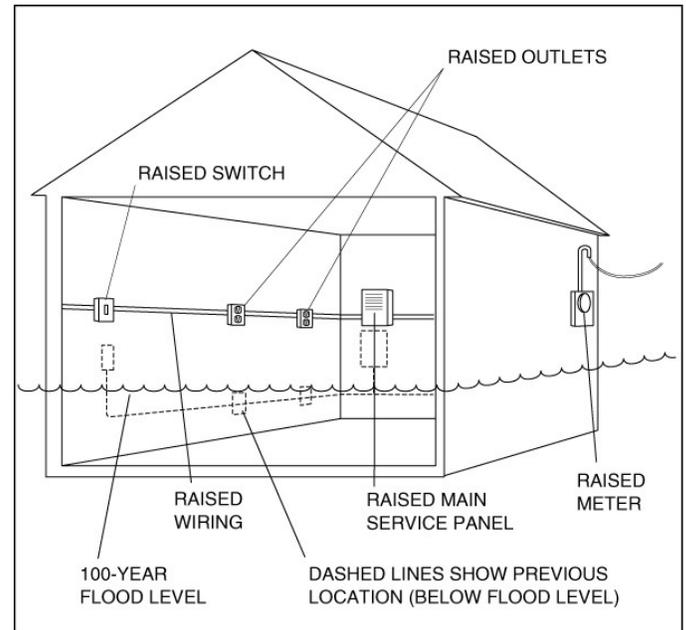


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PROTECTING YOUR PROPERTY FROM FLOODING

Electrical system components, including service panels (fuse and circuit breaker boxes), meters, switches, and outlets, are easily damaged by flood water. If they are inundated for even short periods, they will probably have to be replaced. Another serious problem is the potential for fires caused by short circuits in flooded systems. Raising electrical system components helps you avoid those problems. Also, having an undamaged, operating electrical system after a flood will help you clean up, make repairs, and return to your property with fewer delays.

As shown in the figure, all components of the electrical system, including the wiring, should be raised at least 1 foot above the 100-year flood level. In an existing structure this work will require the removal of some interior wall sheathing (drywall, for example). If you are repairing a flood-damaged structure or building a new structure, elevating the electrical system will be easier.



Any electrical system components that are the minimum necessary to meet safety requirements can be below the flood level if energized from a distribution panel located above the flood level and supplied by branch circuits originating from ground-fault circuit-interrupter breakers.

BENEFITS OF UTILIZING THIS MITIGATION STRATEGY

- Helps to prevent damage to electrical system components, resulting in faster cleanup and repairs
- Helps to prevent fires

TIPS

Keep these points in mind when you have your electrical system components raised:

- ✓ Electrical system modifications must be done by a licensed contractor who will ensure that the work is done correctly and according to all applicable codes. This is important for your safety.
- ✓ Your contractor should check with the local power company about the maximum height to which the electric meter can be raised.
- ✓ If your property is equipped with an old-style fuse box or low-amperage service, you may want to consider upgrading to a modern circuit breaker system and higher-amperage service, especially if you have large appliances or other electrical equipment that draws a lot of power.

ESTIMATED COST

Raising the electrical service panel, meter, and all of the outlets, switches, and wiring in a 1,000-square-foot, single-floor structure will cost about \$1,500 to \$2,000. If this work is performed during the repair of a damaged structure or construction of a new structure, the cost may be much lower.

OTHER SOURCES OF INFORMATION

FEMA 348, *Protecting Building Utilities from Flood Damage*, Chapter 3, November 1999, <http://www.fema.gov/library/viewRecord.do?id=1750>.

FEMA P-499, *Home Builder's Guide to Coastal Construction*, "Protecting Utilities," Technical Fact Sheet No.8.3, December 2010, <http://www.fema.gov/library/viewRecord.do?id=2138>.

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Anchor Fuel Tanks



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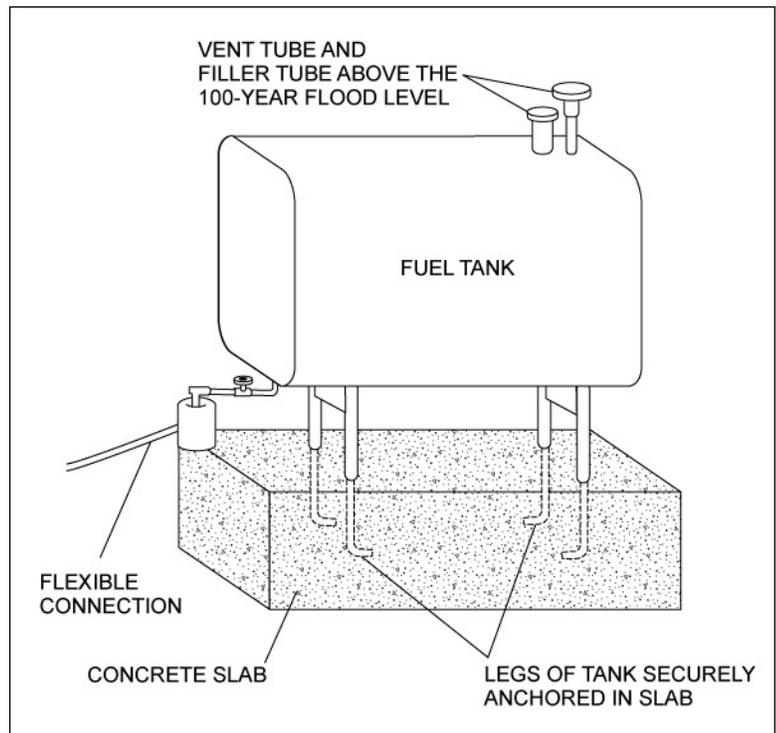
PROTECTING YOUR PROPERTY FROM FLOODING

Unanchored fuel tanks can be easily moved by flood waters, posing serious threats not only to you, others, and your property, but also to public safety and the environment. An unanchored tank outside your building can be driven into the building walls by flood waters, or it can be swept downstream, damaging other houses. When an unanchored tank in your basement is moved by flood waters, the supply line can tear free and your basement can be contaminated by oil. Even a buried tank can be pushed to the surface by the buoyant effect of soil saturated by water.

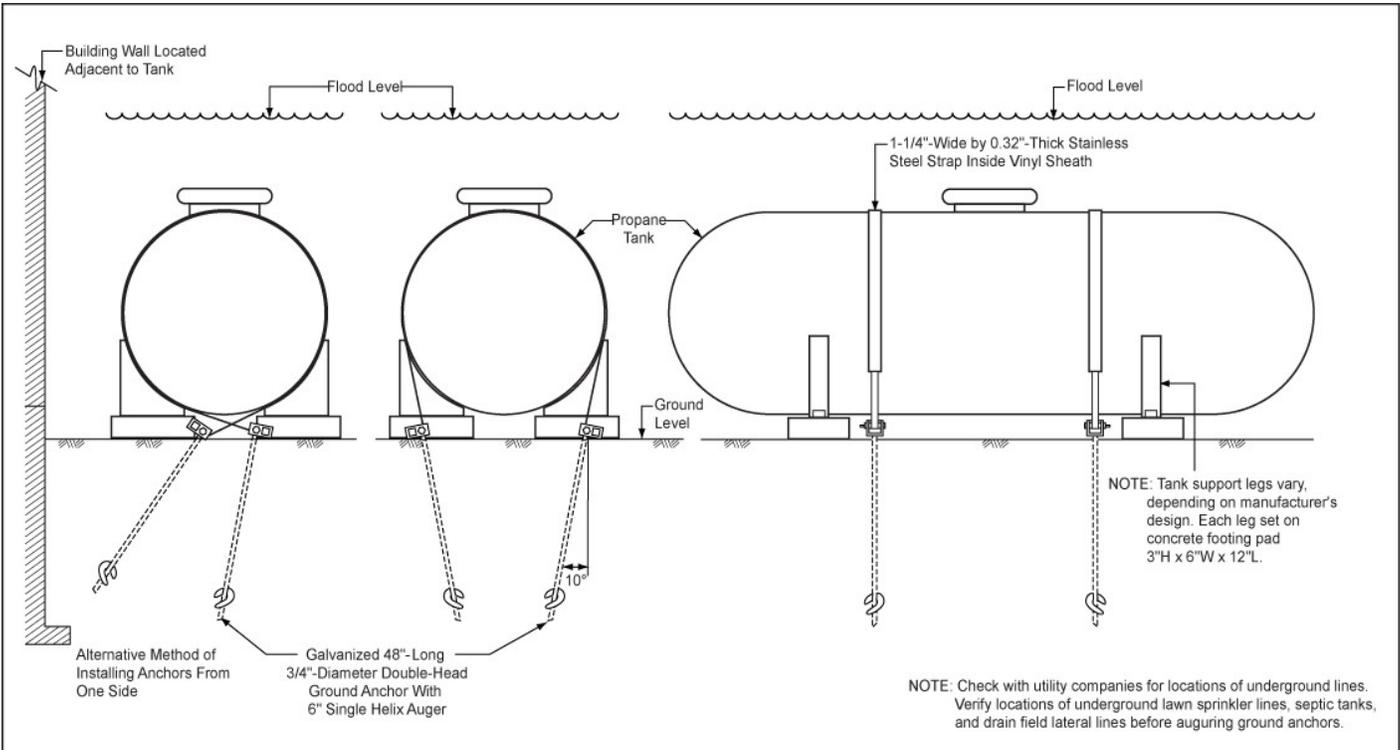
As shown in the first figure, one way to anchor a fuel tank is to attach it to a large concrete slab whose weight is great enough to resist the force of flood waters. This method can be used for all tanks above ground, both inside and outside your property. You can also anchor an outside tank by running straps over it and attaching them to the concrete slab by using turnbuckles.

Propane is stored in pressurized vessels as liquefied petroleum gas (LPG), which can be extremely volatile and potentially explosive if the tank is ruptured and the escaping LPG is ignited by a spark. As shown in the second figure (next page), an inexpensive way to secure a horizontal outside propane tank is to install four ground anchors connected across the top of the tank with metal straps. Secure a vertical tank (120-gallon, 420 lb. size) with two ground anchors. Set each anchor on opposite sides of vertical tank. Attach a strap from each anchor to the collar secured around top of the tank. Attach another metal

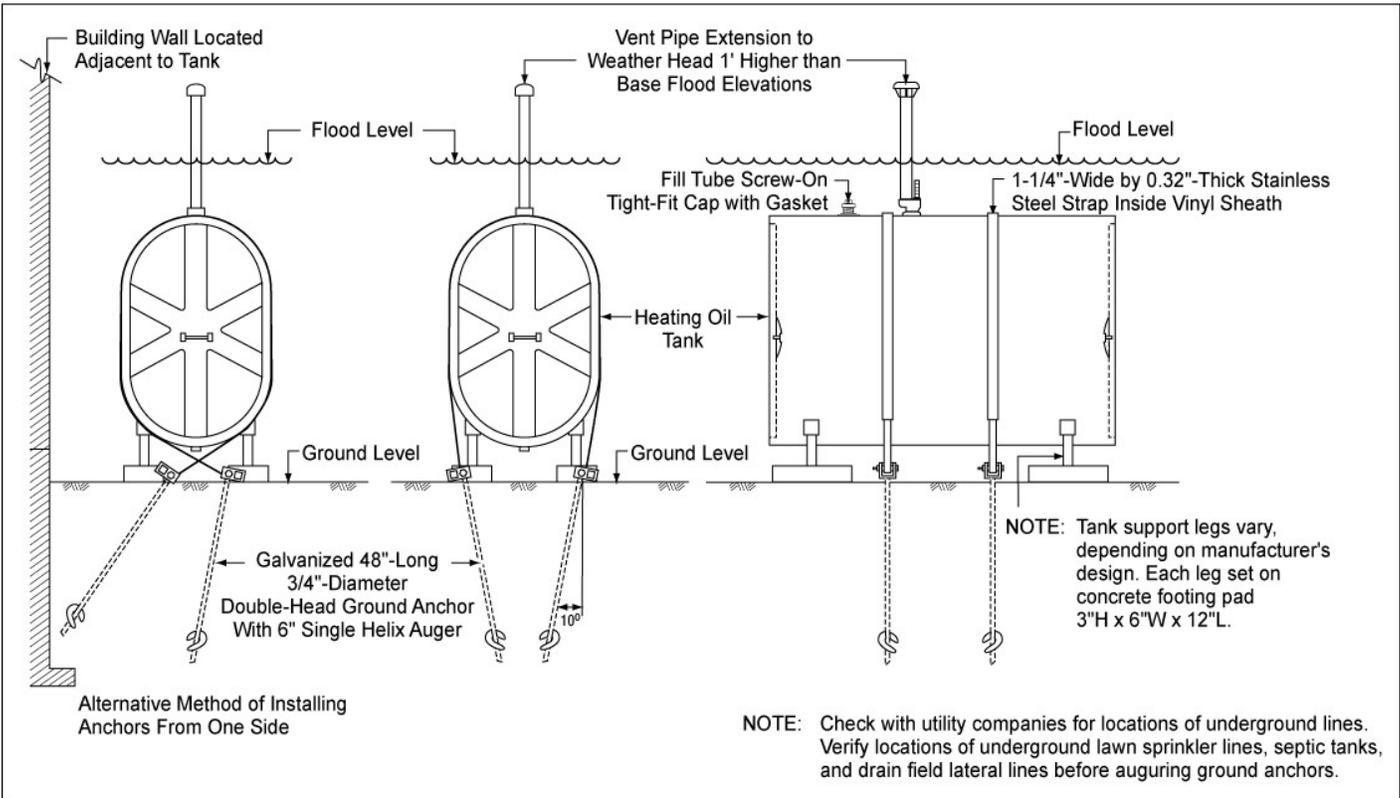
strap connected from one anchor to the other through tank base. The ground anchors and straps described below are the same products that are required by building codes to tie down mobile homes. These products are available from suppliers and installers that service the manufactured housing industry. Similar products can be used to anchor an outside heating oil tank. As is illustrated in the third figure (next page), one way to secure the oil tank is by running straps over it and attaching them to ground anchors.



Anchoring a fuel tank.



Anchoring an outside propane tank.



Anchoring an outside heating oil tank.

BENEFITS OF UTILIZING THIS MITIGATION STRATEGY

- Helps to prevent damage and contamination to a structure and neighboring structures
- Helps to protect public health and safety, as well as those of the structure's occupants, in addition to protecting the environment

TIPS

Keep these points in mind when you anchor a fuel tank:

- ✓ If you prefer not to do this work yourself, you can have a handyman or contractor anchor your tank.
- ✓ Extend all filling and ventilation tubes above the 100-year flood level so that flood waters cannot enter the tank.
- ✓ Close all connections when flood warnings are issued.

ESTIMATED COST

Anchoring a 1,000-gallon fuel tank to a concrete base will cost approximately \$300 to \$500.

OTHER SOURCES OF INFORMATION

FEMA 259, *Engineering Principles and Practices for Retrofitting Flood Prone Residential Buildings*, January 1995, <http://www.fema.gov/library/viewRecord.do?id=1645>. (New FEMA 259 will be available in the Fall of 2011.)

FEMA 348, *Protecting Building Utilities from Flood Damage*, Chapter 3, November 1999, <http://www.fema.gov/library/viewRecord.do?id=1750>.

FEMA P-499, *Home Builder's Guide to Coastal Construction*, "Protecting Utilities," Technical Fact Sheet No. 8.3, December 2010, <http://www.fema.gov/library/viewRecord.do?id=2138>.

FEMA 481, *Anchoring Home Fuel Tanks* (DVD), <http://www.fema.gov/library/viewRecord.do?id=2021>.

FEMA, *Anchoring Home Fuel Tanks* (Video), <http://www.youtube.com/watch?v=qVTSWXnLmC4>

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Install Sewer Backflow Valves



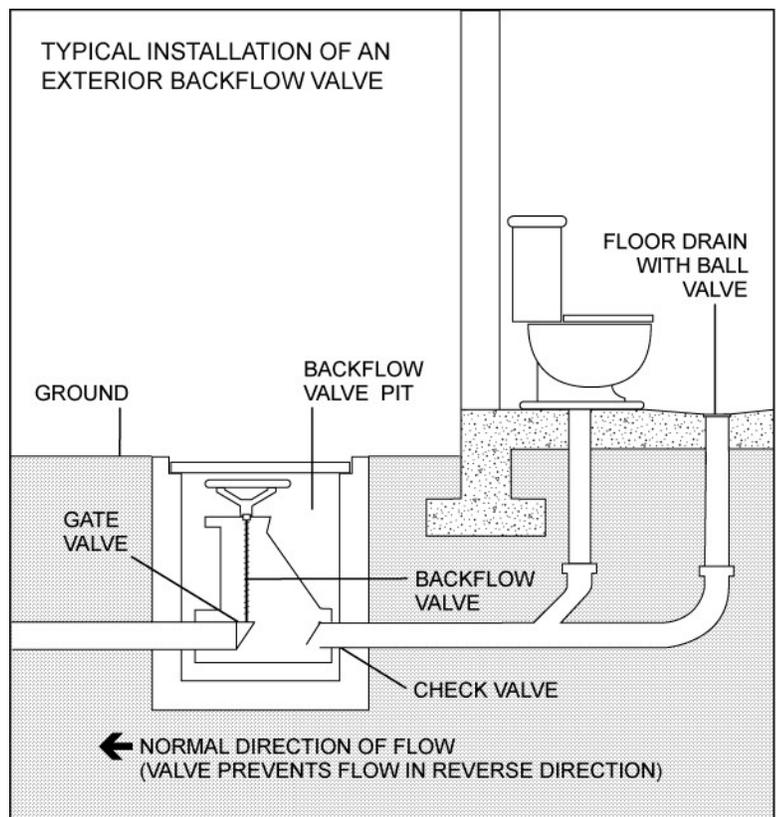
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PROTECTING YOUR PROPERTY FROM FLOODING

In some floodprone areas, flooding can cause sewage from sanitary sewer lines to back up through drain pipes into buildings. These backups not only cause damage that is difficult to repair but also create health hazards.

A good way to protect buildings from sewage backups is to install backflow valves, which are designed to block drain pipes temporarily and prevent return flow. Backflow valves are available in a variety of designs that range from the simple to the complex. The figure shows a gate valve, one of the more complex designs. It provides a strong seal, but must be operated by hand. The effectiveness of a gate valve will depend on how much warning you have of impending flooding.

Among the simpler valves are flap or check valves, which open to allow flow out of the structure but close when the flow reverses. These check valves operate automatically but do not provide as strong a seal as a gate valve.



BENEFITS OF UTILIZING THIS MITIGATION STRATEGY

- Helps to prevent damage to a structure and avoids hazardous and costly cleanup.
- Helps to protect the health and safety of the structure's occupants

TIPS

Keep these points in mind if you have backflow valves installed:

- ✓ Changes to the plumbing in your property must be done by a licensed plumber or contractor, who will ensure that the work is done correctly and according to all applicable codes. This is important for your safety.
- ✓ Some valves incorporate the advantages of both flap and gate valves into a single design. Your plumber or contractor can advise you on the relative advantages and disadvantages of the various types of backflow valves.
- ✓ Valves should be installed on main waste drain pipes that leave the structure or that are connected to equipment that is below the potential flood level. Therefore, valves may be needed on washing machine drain lines, laundry sinks, fuel oil lines, rain downspouts, and sump pumps, as well as sewer/septic

connections.

- ✓ If you have a sump pump, it may be connected to underground drain lines, which may be difficult to seal off.

ESTIMATED COST

Having a plumber or contractor install one backflow valve will cost approximately \$1,400 for a combined gate/flap valve or about \$600 for a flap valve. These figures include the cost of excavation and backfilling.

OTHER SOURCES OF INFORMATION

FEMA 348, *Protecting Building Utilities from Flood Damage*, November 1999, <http://www.fema.gov/library/viewRecord.do?id=1750>.

FEMA P-499, *Home Builder's Guide to Coastal Construction*, "Protecting Utilities," Technical Fact Sheet No. 8.3, December 2010, <http://www.fema.gov/library/viewRecord.do?id=2138>.

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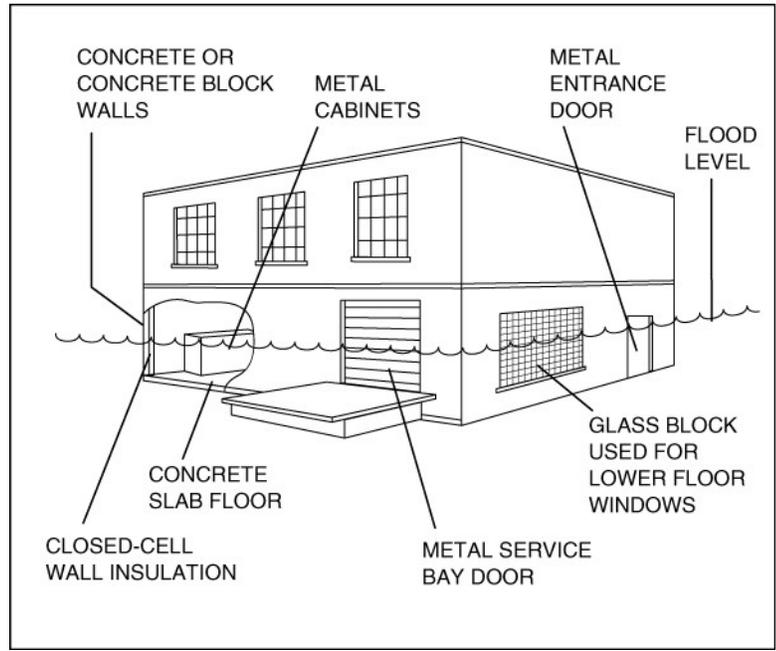
Build with Flood Damage Resistant Materials



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PROTECTING YOUR PROPERTY FROM FLOODING

If your property is in a flood hazard area, you can reduce the damage caused by flood waters and make cleanup easier by using flood damage resistant building materials. Building materials are considered flood resistant if they can withstand direct contact with flood waters for at least 72 hours without being significantly damaged. "Significant damage" means any damage that requires more than low cost, cosmetic repair (such as painting). As shown in the figure, flood damage resistant materials should be used for walls, floors, and other parts of a building that are below the base flood elevation (BFE). Both FEMA and the U.S. Army Corps of Engineers have published lists of these materials (see "Other Sources of Information" section). Commonly available flood damage resistant materials include the following:



Flooring Materials

- concrete, concrete tile, and pre-cast concrete
- latex or bituminous, ceramic, clay, terrazzo, vinyl, and rubber sheets and tiles
- pressure-treated (PT) or decay resistant lumber
- PT wood and cold-formed steel

Wall and Ceiling Materials

- brick, metal, concrete, concrete block, porcelain, slate, glass block, stone, and ceramic and clay tile
- cement board, cold-formed steel, and reinforced concrete
- polyester epoxy paint
- PT and decay resistant lumber
- PT and marine grade plywood
- foam and closed-cell insulation
- decay resistant wood

Other

- hollow metal doors, cabinets, foam or closed-cell insulation

BENEFITS OF UTILIZING THIS MITIGATION STRATEGY

- ✓ Helps to prevent damage to a structure and make cleanup easier

TIPS

Keep these points in mind when you build with flood damage resistant materials:

- ✓ Remember that as long as your structure remains exposed to flooding, it will likely be damaged, even when you use flood damage resistant materials. Some amount of cleanup and cosmetic repair will usually be necessary. Although using flood damage resistant materials can reduce the amount and severity of water damage, it does not protect your buildings from other flood hazards, such as the impact of floodborne debris.
- ✓ All hardware used in areas below the flood level should be made of stainless or galvanized steel.
- ✓ Flood insurance will not pay a claim for damaged finishing materials below the BFE, even if those materials are considered flood damage resistant.
- ✓ If your property is in a coastal flood hazard area, installing flood damage resistant materials in areas below the BFE may create an obstruction, in violation of National Flood Insurance Program (NFIP) regulations. Check with your local building official or floodplain manager before making any modifications to your buildings.
- ✓ Areas of a structure that are below the BFE should be used only for parking, storage, and access.
- ✓ Flood damage resistant materials are also required by the International Building Code (IBC). See your local building code official for additional information.

ESTIMATED COST

The cost of using flood damage resistant materials will vary, depending on the size of the project you undertake. Your local building official and contractors can provide cost estimates for materials and installation.

OTHER SOURCES OF INFORMATION

FEMA Technical Bulletin 2, *Flood Damage-Resistant Materials Requirements for Buildings Located in Special Flood Hazard Areas*, August 2008, <http://www.fema.gov/library/viewRecord.do?id=1580>.

FEMA Technical Bulletin 3-93, *Non-Residential Floodproofing - Requirements and Certification for Buildings Located in Special Flood Hazard Areas*, April 1993, <http://www.fema.gov/library/viewRecord.do?id=1716>.

Flood Resistant Design and Construction, ASCE/SEI 24-05, American Society of Civil Engineers (ASCE), <https://www.asce.org/bookstore/book.cfm?book=5661> or <http://pubs.asce.org/books/standards>.

Floodproofing Regulations, EP 1165-2-314, U.S. Army Corps of Engineers, December 15, 1995, <http://www.usace.army.mil/publications/eng-pamphlets/ep1165-2-314/toc.htm>.

International Residential Code® (IRC®), Chapter 5, "Floors"; Chapter 6, "Wall Construction," 2009.

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