

FLOOD PREPAREDNESS AND RESPONSE HANDBOOK

Nebraska Natural Resources Commission
Flood Plain Management Section



FLOOD PREPAREDNESS AND RESPONSE HANDBOOK

Developed by

the

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SECTION 1

INTRODUCTION

PURPOSE AND SCOPE

The purpose of this handbook is to provide property owners, developers, and public officials with a source of specific information and procedures for dealing with flood hazards and the property damage which can result from a flood.

It is important for property owners or occupants of the flood plain to have an understanding of flood preparedness and response techniques in order to reduce their potential for loss. As in most cases, homeowners must accept the responsibility of protecting their property, since during a flood, public officials will be directing their efforts toward providing emergency services to the community.

With respect to personal safety, people should know what to do if a flood does, indeed, occur. They should take the time to develop evacuation plans for all emergencies, know how to react if an emergency develops, and know where they can get assistance in responding and recovering from the emergency.

The following sections of this handbook will discuss those things that people should be aware of in response to a possible flood. Included in these will be specific information relating to preparation for a flood, actions recommended during a flood, and ways to recover from a flood.

After reading through this handbook and before you make any decisions on protective measures, you should first obtain some detailed information on the type of flooding and the extent of damages you could

expect. The best source of this information is your city engineer, building department, planning agency, or other local official. No one can predict what the next flood will be like. However, from your discussions with these local officials, you should be able to answer the following questions:

- * Is your property in a flood plain?
- * How much warning will there be before a flood?
- * How deep can the flood waters get?
- * Will there be fast currents or debris?
- * Is the community participating in the National Flood Insurance Program?

Once you have the answers to these questions you should be able to decide on the extent of preparedness you should seek.

Be advised, however, flooding can be a dangerous situation. In many areas, flood depths and velocities can be substantial and, thus, very hazardous to your health. Keep this in mind when considering what protective measures you will take.

This handbook is intended only to provide ideas to reduce the threat of flooding to life and property. It does not provide a guaranteed solution to your flood problem.

The safest way to withstand a flood is to avoid it. However, since this is not always possible, you should study the damage preventative methods which pertain to you and consider purchasing flood insurance for your structure as well as its contents.

ACKNOWLEDGEMENTS

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SECTION 2

DEFINITIONS AND CONDITIONS

FLOODS

Life along our rivers brings along with it the danger of floods. Some floods are seasonal, as when winter or spring rains and melting snow drain down narrow tributaries filling river basins with too much water, too quickly. Others are flash floods — the result of heavy precipitation — raging torrents that rip through river beds and surge over their banks sweeping everything before them.

A special river and reporting network is maintained by the National Oceanic and Atmospheric Administration (NOAA) through its National Weather Service. Rainfall and river data are analyzed continually to provide river forecasts and flood warnings. The flood warning service is part of NOAA's environmental monitoring and prediction program. Timely warnings are provided of atmospheric hazards like hurricanes, tornadoes and other severe storms and of earthquake-generated seismic sea waves. These flood warnings give residents time to evacuate low-lying areas, to move property and livestock to higher ground, and to take necessary emergency action.

Gauges mark the height of water in the river basin. The local Weather Service Office can tell you where the nearest river gauge is located in relation to your property. Every resident in an area subject to flooding should know the elevation of his property and how it relates to the river gauge. Flood warning broadcasts may make reference to a flood stage level at a location other than the nearest river gauge. You should know before the flood the relative elevation of your property in relation to flood stage level broadcasts. The city or county engineer probably can help to provide this information. Factors that affect the critical flood stage level for a specific property include:

- * Elevation of your property in relation to the reference flood stage levels
- * Flood history of your area
- * Effects of flood control projects or other man-made changes
- * Potential flooding conditions of evacuation routes, particularly bridges and low level roadways

Forecast procedures are designed by hydrologists, who study the history of each storm. Relationships between precipitation, melting snow, soil conditions, and stream-flow are analyzed; and river forecasting procedures are developed. The hydrologist predicts the amount of water that will flow into rivers and streams — and the time it will take to reach them — under different conditions of temperature, soil moisture, and precipitation.

FLOOD WARNINGS

Residents in low-lying areas given early flood warnings have time to get to higher ground with their personal property, mobile equipment, and livestock. Crops may be harvested before the flood in some cases. Preparations for handling refugees and the impending health hazards caused by the flood also can be made by emergency relief teams.

Flood warnings are broadcast over radio and television, and they are made by emergency agencies. Such warnings tell whether the flood is expected to be minor, moderate, or severe, and they give the name of the river and the time and place of flooding. Careful preparation and prompt response will reduce property loss and ensure personal safety.

FLASH FLOODS

Flash floods are treacherous. They follow heavy precipitation, move quickly and carry with them uprooted trees, remains of buildings washed away, and any other mud and debris that has been picked up farther upstream.

Persons living in low-lying areas should know the elevation of their property and that of streams and waterways near them. Know ahead of time areas that are safe and what to do in a flash flood emergency.

No stages can be forecast in flash floods. Severity of expected flash flooding may be indicated by terms such as minor, moderate, or severe.

Communities are alerted to flash floods by a "flash-

flood watch” and a “flash-flood warning.”

In the event of a flash-flood watch, listen to radio and television stations for a possible flash-flood warning and reports of flooding in progress. Be prepared to move out of danger’s way at a moment’s notice. If on a road, watch for flooding at bridges, dips, and low areas. Watch for signs (thunder, lightning, etc.) of distant rainfall.

HOW FLOODS DAMAGE PROPERTY

Few people realize the force of flood waters unless they have witnessed them. A 100-mile-per-hour wind blowing on the side of a house would be equal to about 12 inches of water flowing at 10 miles per hour against the same wall even though the distribution of forces would be different. Water 1-foot deep flowing at 20 miles per hour against the wall would be 4 times as strong as a 10-mile-per-hour water current at the same 1-foot-depth.

None of this considers water erosion around the house, suction behind it, or the battering it receives from objects inside and out. Possible damage resulting from these is considerable.

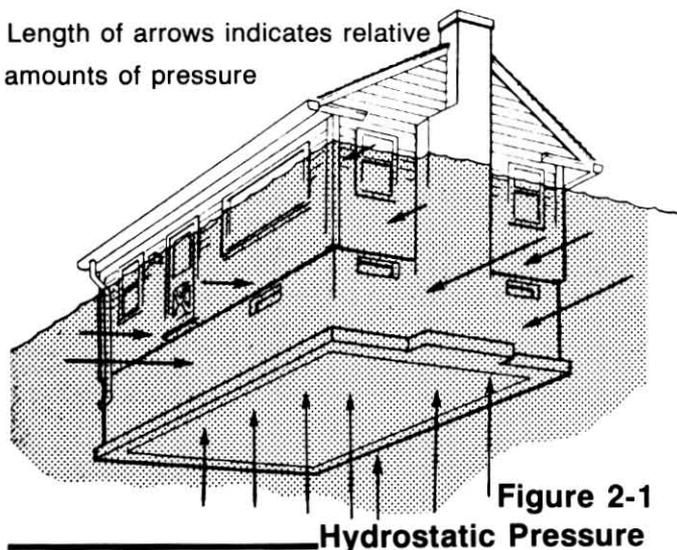
Several factors determine how much damage flood waters will cause to homes. For instance, how long was it submerged? If water rises and falls rapidly, relatively less damage can be expected because some materials absorb water slowly. Property exposed to water for days or weeks will become thoroughly soaked and damage will be extensive.

The following examples illustrate some of the ways damage to the structure can occur.

HYDROSTATIC PRESSURE

Hydrostatic pressure, or the force resulting when a head (depth) of water, or of wet soil, is opposed by a surface such as a wall or basement slab affects underwater portions of a house in the same way that water pressure affects a diver. Greater depths of water exert greater pressures on the structure. See Figure 2-1.

Length of arrows indicates relative amounts of pressure

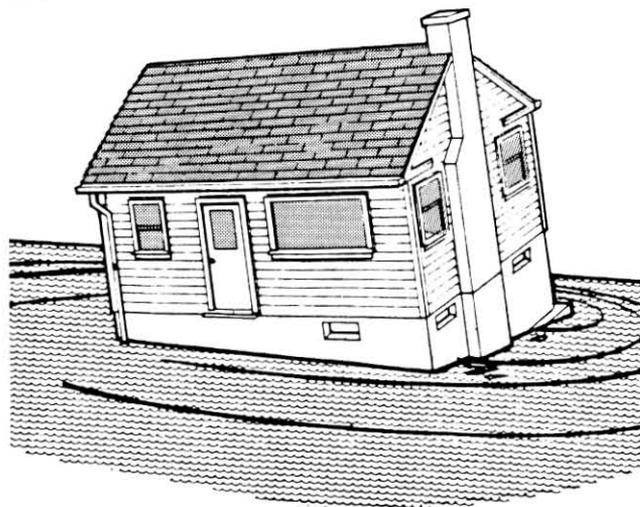


At a depth of 5 feet (an average below grade depth of basement walls) water exerts over 300 pounds of pressure per square foot of surface. Fortunately, there is frequently a tortuous path through relatively impervious soil from water on the surface to basement walls and to the underside of the basement floor. If it were not for relatively impervious soil, water pressure from a flood or a heavy rain, could easily break the average basement slab floor. The alternative to relying upon this uncertain protection is to build a reinforced or braced basement that is designed to withstand full pressure. Builders have learned from many years of experience that certain conventional structural specifications will usually withstand the water pressures to which they are subjected. Occasionally, however, the variable factors combine adversely resulting in structural failure.

Pressure on structures is caused by differential hydrostatic pressures; that is, the difference between outside pressure and inside pressure. If this cannot be lowered by reducing the outside hydrostatic pressure, the alternative is to increase the inside pressure. This can often be accomplished by providing an inside water level (inside the basement or house) that will offset the outside hydrostatic pressure. For this reason, some home owners deliberately fill their basements with water or leave the doors open to allow water to enter. These procedures can cause some damage, but they are often preferred to the chance of structural failures.

BUOYANCY

An object in water is buoyed by an upward force equal to the weight of the water displaced. Each cubic foot of water that is displaced by the structure exerts enough buoyant force to float about 62 pounds. This upward movement is opposed by two forces — first, the weight of the house and its furnishings, and second, by the frictional shear forces of the soil against the underground foundation walls and footings. See Figure 2-2.



An average 1-story house with basement could reach a buoyant condition and begin to float out of the ground when outside water has reached about 3 feet above the level of the basement floor. Fortunately, the entire wall and underfloor areas are not fully saturated in most cases. The buoyant condition is caused by only those areas that are saturated. As a consequence, buoyant basements are less frequent than a simple application of the basic laws of physics would predict. Most basements also have an effective, but not very efficient, built-in protective device. Under-slab upward hydrostatic loads will usually rupture the floor slab before a buoyant condition is reached. This allows water to flow into the basement and reduces the amount of water displaced.

The basementless house will float if trapped air inside the house displaces enough water. An average 1-story house will float when water reaches about to the eaves. An important factor here is the strength of the sill anchor system. Effective anchor bolts or straps tie the house to its foundation and greatly improve its resistance to the buoyant force.

BATTERING

The battering of rushing water, waves, or objects floating in the water can create extensive danger. See Figure 2-3.

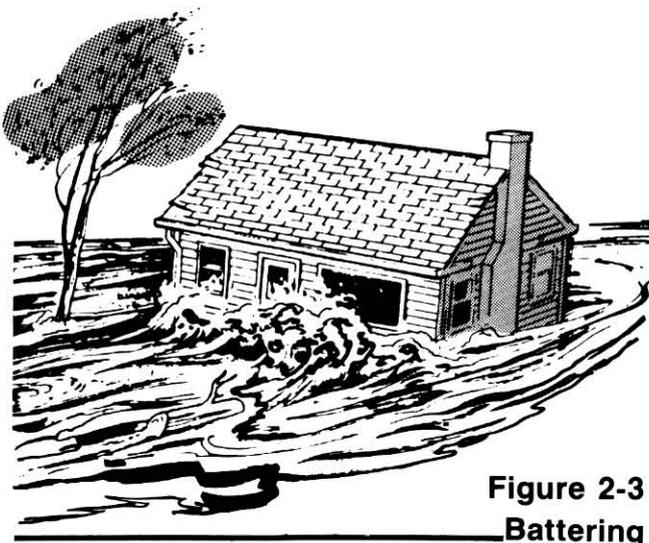


Figure 2-3
Battering

Battering waves can destroy masonry or concrete structures which have limited lateral strength. Reinforcing steel, properly added during construction, can greatly improve resistance to the impact of waves. Coastal buildings are sometimes built with breakway wall panels on the ground floor. These panels are sacrificed to the wave action while the piles or piers continue to support upper floors of the house and present relatively little surface to impact of the waves.

PULSATING WATER

Pulsating action is most pronounced inside the house. Water rushing in is stopped by an opposite wall and returned toward its place of entry. See Figure 2-4. These oscillations can approach a natural frequency of pulsation, which sustains and amplifies the motion. Floating contents and debris, caught up in the oscillating motion, can act as battering rams. Furnishings and structural elements may be seriously damaged by these pulsating waters.



Figure 2-4
Pulsating

TRANSLATION

Houses may be pushed off their foundations by moving water; such lateral movement of the structure is called translation. See Figure 2-5. If forces from water occur unevenly around the building, it may rotate.

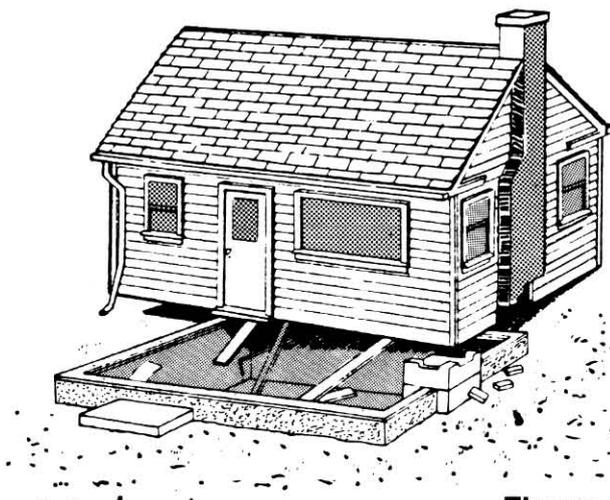


Figure 2-5
Translation

An effective sill anchoring system can be a major protective factor in preventing translation or lifting of the building. The buoyant force, by reducing effective dead weight of the structure, can make a house more vulnerable to translation.

SCOURING

Scouring action washes away stabilizing soil and undermines structures. See Figure 2-6. Scouring can be caused by wave action and it is often amplified around the corners of structures where the sweep of water forms swirls and ripples which erode the underlying soil. This action at corners can often be alleviated by proper soil compaction or stabilization, vegetation, or buried but slightly exposed structural wing walls.



Figure 2-6
Scouring

OVERTURNING

Rushing water or wave action can combine with buoyant forces or a bottom snagging effect to overturn a structure onto its side. See Figure 2-7.



Figure 2-7
Overturning

SECTION 3 BEFORE THE FLOOD

FLOOD PLAIN MANAGEMENT

Flood Plain Management can be simply defined as the operation of an overall community program of corrective and preventive measures for reducing flood damage.

Such preventive measures can include emergency preparedness plans, local zoning and subdivision regulations, building codes, flood insurance, flood warning systems, and even structural projects in the form of dams and levees.

Primarily, flood plain management regulatory programs are concerned with the so-called 100-year frequency flood. This terminology has caused a great deal of confusion over the years in that, for some reason, people tend to think of this as meaning there will be only one flood every one hundred years. This, certainly, is not the case.

The terminology used in describing the 100-year flood refers to the probability of occurrence of a flood of a given size. For example, the phrase 100-year flood means that there is a 1.0% chance of having a flood of that size in any given year. In comparison, a 500-year flood has a .2% chance of occurring any given year.

The probability of having a large flood soon after another is very slim. However, it does happen. There are known cases where 100-year floods have occurred back-to-back as soon as the original flood waters receded.

Of major concern to flood plain management programs is the regulation of development in the designated floodway of the flood plain. The floodway is that portion of the flood plain which is needed to carry and discharge the flood waters of the 100-year flood. Generally, this includes the channel and equal portions of the innermost part of the entire flood plain.

Development in the floodway is, in almost all cases, prohibited as this is the most dangerous area of the flood plain for human occupancy and dwelling.

Flood plain management programs are generally locally administered with guidance coming from numerous state and federal agencies. For specific information on your community, you should contact your local public officials.

FLOOD INSURANCE

Because houses located in flood plains can be expected to flood, most commercial insurance policies **do** not cover flood damages. Check your homeowner's or renter's policy (many mobile home policies do include flood insurance). If you are not insured, you still may be able to purchase a National Flood Insurance Program (NFIP) flood insurance policy.

NFIP flood insurance can be sold by any licensed property insurance agent who wants to. Your agent can tell you if NFIP insurance is available in your community. If it is not, contact your city or county officials about joining the program.

Coverage

A flood insurance policy covers direct loss by a flood (less the deductibles). A flood is defined as a "general and temporary condition of partial or complete inundation of normally dry land areas" from:

1. the overland flood of a lake, river, stream, ditch, etc.,
2. the unusual and rapid accumulation or runoff of surface waters, and
3. mudslides, mudflows, or collapse of shoreline land.

You can buy structural coverage for any walled and roofed building, including a mobile home. Any building in a community that has joined the NFIP can be insured, whether or not the building is in a flood plain.

Structural coverage covers damages to your walls, floors, insulation, and other items permanently attached to the structure. Standing water will ruin drywall and can severely damage a wood floor or panelled wall. It is therefore important that a homeowner purchase an adequate amount of structural coverage.

You can also buy contents coverage on the contents of an insurable building even without buying structural coverage.

Many people were required to buy flood insurance in order to get a mortgage or home improvement loan.

Generally, the requirement was for structural coverage only. Therefore, people who think they are insured should double check to make sure that they have their contents insured.

An NFIP flood insurance policy will not cover vehicles, boats, animals, crops in the field, money, valuable papers, fences, docks, outdoor swimming pools, land values, plants, trees, or driveways. It will normally cover most expenses incurred in moving your belongings to safety in advance of a flood. It will cover damages caused by sewer backup if the cause of backup was a general condition of flooding (see definition of a flood) and if the structure is damaged directly by that flood.

IMPORTANT NOTE: There is a **five day waiting period** before your coverage goes into effect. The policy will not cover damages from a flood in progress at the end of the five days. Therefore, it is generally too late to buy a policy after the flood warnings are issued. You should talk to your insurance agent now. If he is not familiar with the NFIP, he should call, toll-free (800) 638-6620.

Advantages of Flood Insurance

NFIP flood insurance is in most cases, federally subsidized. Houses subject to frequent flooding are being protected with the homeowner paying as little as 10% of the true cost. For most of the other measures discussed in this manual, the homeowner pays 100% of the cost.

NFIP flood insurance covers all floods, no matter how large. A levee, for example, may only protect you from a 10 or 50 year flood.

There is no reliance on human intervention, you are covered as long as your policy is in force.

Problems of Flood Insurance:

NFIP flood insurance is not available everywhere. Although most flood prone communities have joined, the governing bodies of some are reluctant to begin regulating future flood plain construction.

Flood insurance does not protect your house from flood damage; it merely repays you for most of the costs associated with the damage. If you have adequate warning of a flood, a policy will cover the cost of moving your contents to high ground. Otherwise, your house will receive damage, you will pay the deductibles, you will not be reimbursed for damage to uninsurable items, and you will not be reimbursed for the hardships suffered.

Premium Rates

Rates charged for flood insurance are, in many cases, dependent upon several factors and variables. Among these are the status of the community in the

NFIP, the type of structure, the type of flood zone the structure is located in, and several others. For further rate information, you should contact your local insurance agent.

SURFACE WATER DRAINAGE AND DIVERSION

Small levees and floodwalls can be built around one or more houses to keep low flood waters away. A house need not be completely encircled. A wall could be built on the low sides and tied into existing high ground or to dry floodproofed walls of the building. See Figure 3-1.

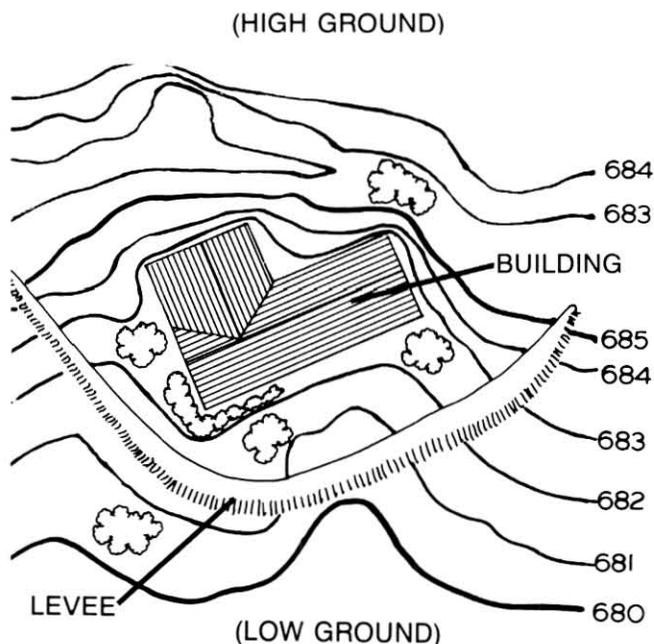


Figure 3-1
—Surface Water Drainage and Diversion

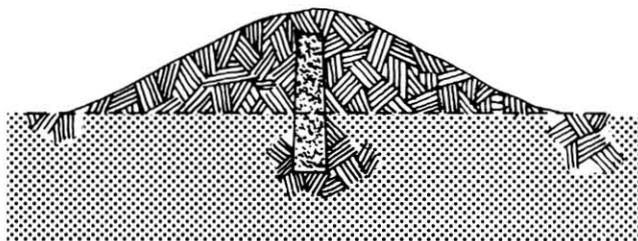
Levees

Levees made of local or borrow dirt are probably the cheapest way to keep floodwaters off a site. Key things to check are:

1. Do you have enough room for a levee? The sides of a clay levee should have at least a 2:1 slope. A sand levee requires a 3:1 slope. The base should be even wider to allow for a gradual slope which would be easier to maintain and less of a visual disruption to your landscape.
2. Being made of dirt, a levee is highly susceptible to erosion and scour. Gradual sloping and a good ground cover should minimize this. In areas where past flooding has shown that currents wash away ground cover, well anchored

railroad ties or boards, rip rap (broken rocks) or some other protection measure should be used.

- How permeable is the dirt? Long standing water will seep through it. It will take longer to permeate clay than sand or gravel. Check with your Soil and Water Conservation District or a soil engineering firm for more information. You can find the District phone number by looking under your county's name in the telephone book.
- A levee to be built with relatively permeable soil can be improved by building an impermeable core. The core could be compacted impervious soil, a sheet pile wall, or a concrete wall. Such cores could be tied to an impervious layer to prevent seepage through the underlying soils. See Figure 3-2.



Levee with impermeable core



Shallow levee built up to flower boxes in front of house provides a more pleasing appearance.

Figure 3-2

- The sod and topsoil should be removed and saved for covering the final surfaces. Special measures should be taken if a levee is tied in to a floodproof wall to ensure that there will be no seepage at the joint.
- A levee is built up in layers. Each layer is no more than 9 inches thick before compaction (less if you are compacting by hand). If you will be using both pervious and impervious soils, put the impervious soils on the flood side.

Floodwalls

A floodwall has two advantages over a levee: it takes less space and it is impermeable. It also has two disadvantages: it is typically more expensive and it is harder to blend in with the natural landscape. A floodwall can be "camouflaged" with a brick face, for example, and give the homeowner a privacy fence (don't use a facing that would be damaged by floodwater).

The lateral pressure of standing water increases greatly for every foot of depth. A watertight brick or block wall may not withstand this pressure at a depth of over two feet. There are two ways to build a floodwall strong enough to withstand the pressures of deeper (higher) flood waters:

- Use a lot of material:

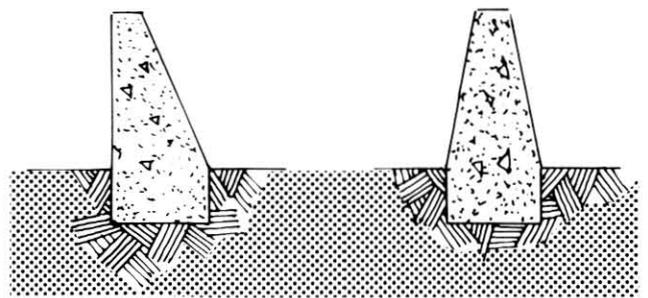
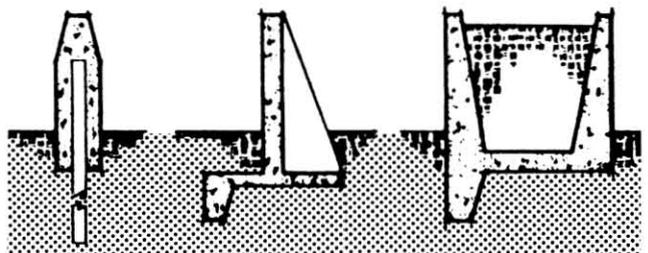


Figure 3-3

- Or anchor and reinforce it:



Sheet
Pile
Core

Dirt
Reinforced

Dirt
Filled

Figure 3-4

Temporary floodwalls can be built with sand bags and plastic sheeting. However, these will deteriorate in a few years and will not be visually pleasing.

Drainage Problems

On smaller lots a levee or floodwall could affect local drainage. It is illegal to block the natural drainage off a neighbor's property. A levee or floodwall could also be an encroachment that could divert a flood or increase flood heights. These factors need to be closely checked with the local building or zoning department.

Because a levee or floodwall keeps water **away** from your property, it could also keep rainwater **on** your property. Some methods of internal drainage should be provided to handle runoff and any seepage. Water should be guided through gutters, trenches, filter drains (trenches filled with permeable gravel), or tiles to one or two low points (sumps). From the low point water could drain under the levee through a tile or be pumped over.

If a tile is used, remember to plug it up during a flood or install a backup valve. Also remember that a tile will not help you drain the area of seepage water during a flood while a pump will.

Some other points to consider:

- * Have your downspouts extended beyond the levee. A levee or floodwall only keeps the water on top of the ground away from your house. Don't forget to take care of sewer back-up.
- * You should also check on the permeability of your underlying soils. Water could seep under your floodwall.

Access

A low levee (under 2 or 3 feet) may not present an access problem. By sloping the fill enough, a ramp or "road bump" can be built.

Another option is to leave a break in the wall and fill it with sandbags when you get the flood warning. To shorten your reaction time, use a gate. Instead of a hinged or sliding gate, put flanges or slots in the face of the opening and drop a board or shield in place. The edges should be sealed with rubber gaskets or folded plastic sheeting.

Advantages of Levees and Floodwalls

- * There is a dry area outside your house which makes it easier and safer to get in and out.
- * There is no water pressure on your building.
- * By protecting several houses at once, each homeowner can save money.

Problems of Levees and Floodwalls

- * They can fail or be overtopped by large floods. If this happens, the effect will be as if your house

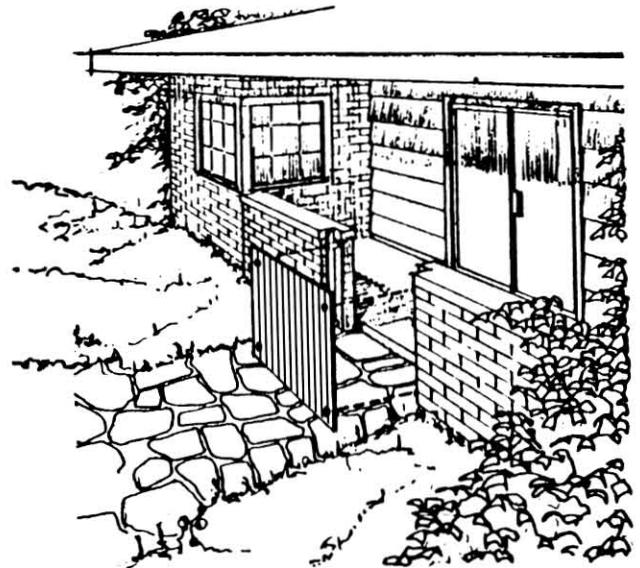


Figure 3-5

had no protection at all.

- * Levees in particular need to be maintained and kept at a uniform level. If several houses are protected, the failure of one owner to maintain his part will lower everyone's protection.
- * Floodwalls also need periodic inspection for cracks from settling, expansion and contraction.
- * They may be prohibited by your local building code, zoning ordinance, or property covenant.
- * They could cause water problems to others.
- * There are internal drainage problems.
- * They would probably not affect regular program flood insurance premiums.
- * Closing access ways may be dependent on human intervention.

Costs

- * Materials - can be kept down if local soil is used.
- * Labor - can be kept down if done by homeowner.
- * Gate - shield or "road bump" - if access needed.
- * Internal drainage and sewer back-up measures.
- * Landscaping or decorative features to improve appearance.
- * Maintenance.

ELEVATION AND EVACUATION

The technology exists to jack up or elevate almost any type of building. Once elevated, the flood waters simply flow underneath, causing no damage. Elevation involves the following steps which should be conducted by a professional contractor or building mover:

1. Disconnect plumbing and other utilities.
2. Emplace jacks and raise the building.

3. Extend the foundation walls or build piers to support the building.
4. Lower the building onto the walls or piers.
5. Reconnect utilities.
6. Rebuild access walks, stairs, etc.
7. Insulate and protect the underside of the first floor and any other newly exposed surfaces.

The key problem with elevation is the cost. This depends on the type of house. (The cost of elevating 8 feet is little more than that for elevating 4 feet. The major expense is setting up.) Cost will be lowest if:

- * The house is light, preferably wood frame.
- * There is at least 18" for access under the first floor.
- * It is small enough to be done without partitioning.

Brick, brick veneer, masonry, and even concrete slab houses can be elevated but their weight and handling problems will increase the cost. We recommend that basements be either filled in or wet floodproofed.

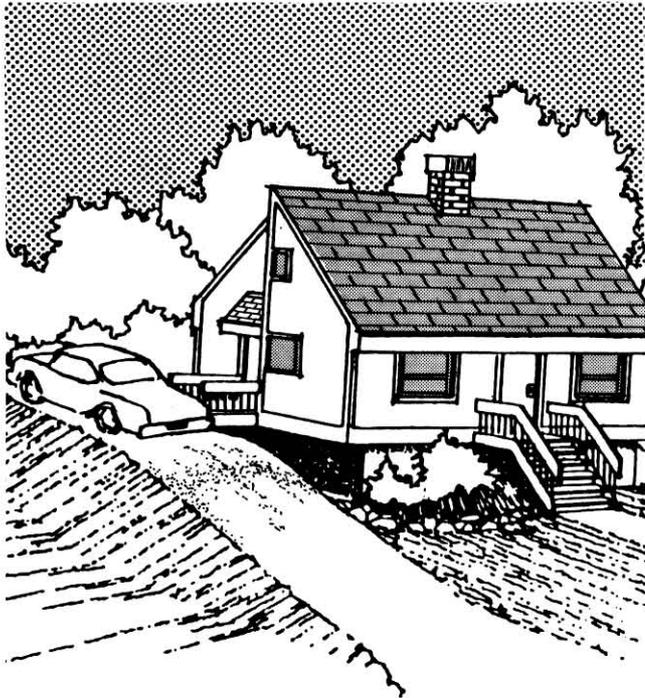


Figure 3-6

Evacuation

As long as the house is raised up, why not move it to a new site on high ground? This is called evacuation and it provides the surest of all methods for protecting your house from flood damage. Although this method may sound farfetched, entire towns have been relocated out of the flood plain.

Advantages of Elevation and Evacuation

- * You don't have to worry about levees, pumps, or other measures failing.
- * The techniques are well known and contractors are readily available.
- * There is no dependence on human intervention.
- * Regular program flood insurance premiums will be reduced (eliminated if the building is evacuated).
- * This technique is particularly applicable for mobile homes, which are not conducive to floodproofing.
- * If elevated high enough, you could give yourself a new carport.

Problems of Elevation and Evacuation

- * Unless the house is evacuated, there will be water under it making access difficult during a flood.
- * Additional expenditures may be needed to improve the appearance.
- * Your basement will probably be unprotected.

Costs

Consult your local contractors. You can expect at least \$5,000 to elevate a building. Evacuation would cost at least \$10,000 more, with most of the cost going to preparation of the new site. These costs would be much less for a mobile home.

DRY FLOODPROOFING

Dry floodproofing is a series of adjustments made to your house to keep water from entering during a flood. The ideas presented in this section are not to be confused with floodproofing measures to be taken when building a new house. Normally, building code requirements are much more restrictive on what is permitted when building a new floodproofed structure.

To dry floodproof an existing building, four factors need to be taken into account:

1. **Static lateral pressure:** the walls must be able to resist the pressures of standing water pushing sideways.
2. **Uplift:** the floor must be able to resist the pressures of water pushing upwards when the ground is saturated.
3. **Waterproofing:** the walls and floor must be watertight and all openings must be closed and made watertight.
4. **Dynamic loads:** the building must be able to withstand the shocks and pressures that may accompany a flood.

Dry floodproofing is a very difficult business. If done wrong, the walls may collapse causing more damage than if the building were permitted to flood. Dry floodproofing measures should be designed by a structural engineer who can prepare the best design that takes into account the peculiarities of your house, soils, and expected flooding. The following ideas are offered with this recommendation for consulting an engineer. These ideas should help you decide if dry floodproofing is feasible for your situation.

Static Lateral Pressure

Water weighs 62.5 pounds per cubic foot. Because it is so fluid, standing water exerts the same pressure sideways that it does downwards. As the depth increases, the pressure at the bottom increases. The formula for computing the pressure is: Static load = $62.5 \text{ lbs/Ft}^3 \times (\text{depth})$

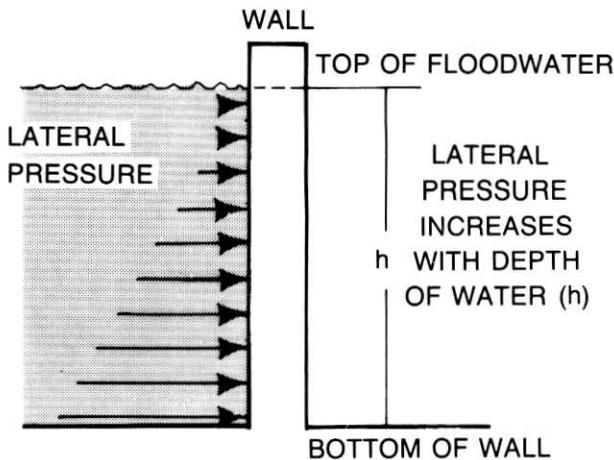
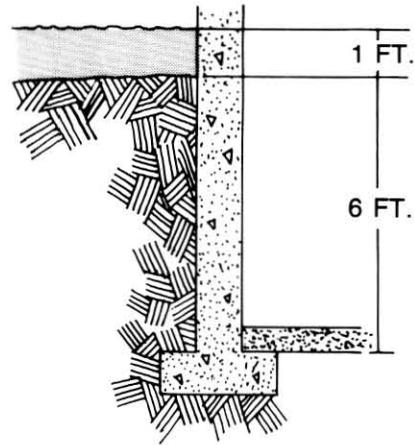


Figure 3-7
Static Lateral Pressure

Using this formula, one can see that the lateral pressure at the bottom of a wall holding back four feet of water is $62.5 \text{ lbs/Ft}^3 \times 4 \text{ Ft} = 250$ pounds per square foot.

As the formula shows, static pressure is dependent on height, not how big an area the flood may cover. Since the effects of weather have caused the ground against most every house to contract away from a basement wall, floodwaters will get an entire basement wall wet. Once wet, the lateral pressure is transferred to the wall and is computed from the floor or base of the wall.

Where the basement floor is 6' underground, a flood depth of 1' above ground exerts the same pressure as 7' of flood water.



7 FT. OF PRESSURE EQUALS 437.5 LBS./FT.² AT BOTTOM

Figure 3-8

What all this discussion means is that the lateral pressures, pressures on your house's walls during a flood, can be tremendous. Most house's walls are not built to hold up against such lateral pressure. In fact, when a new basement is built, the contractor normally does not back fill until the first floor is in place to reinforce the walls to prevent collapsing. For another comparison, the lateral pressure of water can be 2½ times that of soil.

How much pressure can the average wall take? Here are some general rules:

- * A wood frame wall with brick or masonry siding should not be trusted against a flood depth of over 2 feet.
- * A brick wall backed by concrete block should not be trusted against a flood depth of over 3 feet.
- * A concrete basement wall with reinforcing, subsurface drainage, and supported by interior walls at least every 15 feet should withstand flood depths of up to 8 feet. It should be noted that much of the wall's strength comes from the weight of the house on top (structural load). In the Chicago area and other places with high water tables, many houses have been built with concrete basements with some reinforcing rods and subsurface drainage.
- * A wood frame wall will not be watertight.

A homeowner can take two important steps to support the lateral pressure to be expected during a flood:

1. Reinforce the wall.
2. Subsurface drainage.

Reinforcing

A basement wall can be reinforced on the inside by

constructing supporting walls or buttresses. Remember, a typical room dividing wall made of studs and drywall offers no lateral support, whereas a block wall would.

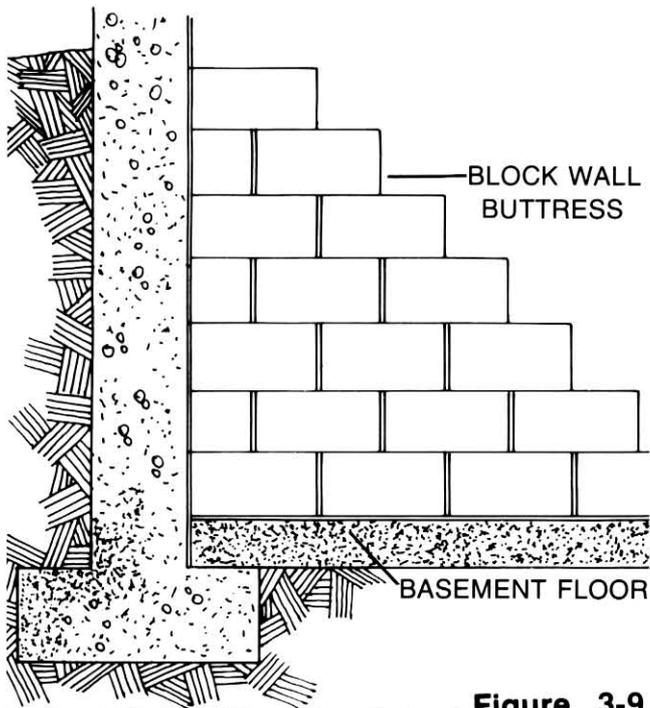


Figure 3-9

The outside of a wall can also be reinforced. The best way would be to build a berm to above the flood level. The greatest benefit of this measure is that the flood waters will not be able to quickly run down the crack between the ground and your basement wall. Waters will be kept away until the berm is saturated. Subsurface drainage should help drain the saturated ground next to the wall.

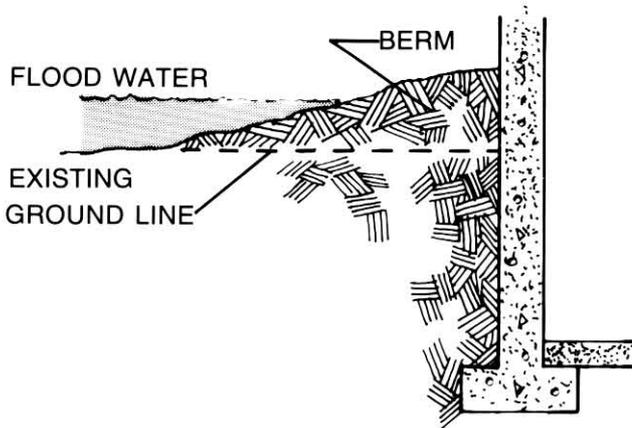
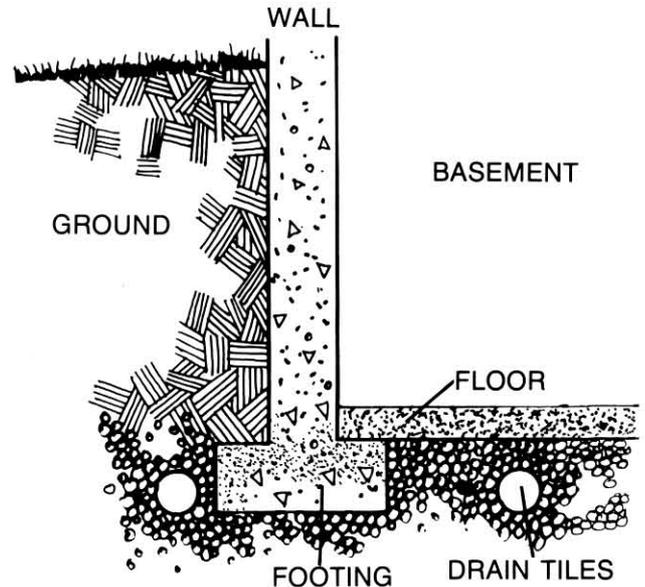


Figure 3-10

Subsurface Drainage

Subsurface drainage can be provided by installing a drain tile around the base of the foundation (footing). The tile drains water seeping through the ground and will therefore relieve the walls of the lateral water pressure. The tile drains to a sump and is pumped out.



Note: The effectiveness of this measure depends on proper soil conditions. Underlying soils may be too permeable.

Figure 3-11

Some precautions:

- * Some houses already have subsurface drainage placed under the floor to relieve a basement floor from the uplift pressures of a high water table. This location is not very effective for draining water on the other side of the footing.
- * Subsurface drainage depends on a pump to work. Pumps that use house current may stop running if electricity is lost during a storm. Back up systems are available that use batteries or gasoline.
- * Subsurface drainage cannot be expected to handle surface flood waters that come down the crack between the ground and your wall. That would be like trying to drain the river with one pump.
- * In most communities it is illegal to connect a sump pump to the sanitary sewer. Water is normally pumped out onto the ground, above the flood height.
- * An alternative to outside tiles is internal drainage or "stone tiling" under your floor. Water seeping through cracks or deliberately drilled holes can be guided along floor drains to the sump. Internal drainage is a good precaution to take even with outside tiles.

Uplift

When the ground under the house gets saturated, the water will push upward seeking its own level. Uplift forces place the house in danger in two ways:

1. The floor could crack or break just as a wall will from lateral pressure.
2. The entire house could be lifted up and, in effect, float.

Again, a structural engineer needs to be consulted. However, here are some general guidelines:

- * A one or two story wood frame house, without basement (even with partial brick or masonry siding), may float if the flood waters reach three feet above the first floor.
- * If three feet of flooding does not float a one or two story house on a slab, it will probably cause the slab to buckle.
- * A basement floor will probably fail when the ground is saturated up to four feet above the floor.
- * Uplift depends on water getting under the house. To protect against this, the ground underneath a slab or basement floor needs to be drained. Sub-surface drainage, discussed above, is the best protection. Subsurface drainage will not help a house on a crawl space. A structural engineer should be consulted on anchoring the building to the ground.

Waterproofing

Dry floodproofing assures the inside of your house will be kept dry. Two things need to be done:

1. The walls need to be sealed.
2. Openings need to be closed and sealed.

Do not trust a wood frame wall or its insulation to be watertight. Brick or masonry mortar will permit seepage. To be sure of your protection, have a commercial sealant applied on brick, masonry, or concrete and have cracks caulked.

Openings

There are several options for dealing with openings that must be closed and sealed for flood protection. Here are some ideas:

- * Basement windows cause the most problems. They can be replaced with glass brick or closed up.
- * Window wells can be built up so the opening is above the flood level. This method will also work on basement doors.
- * Don't forget openings other than doors and windows, such as the dryer vent and fireplace cleanout access.
- * As an alternative to permanently closing an opening, sandbags, a gate, or a moveable shield can be emplaced if there is adequate warning (see the

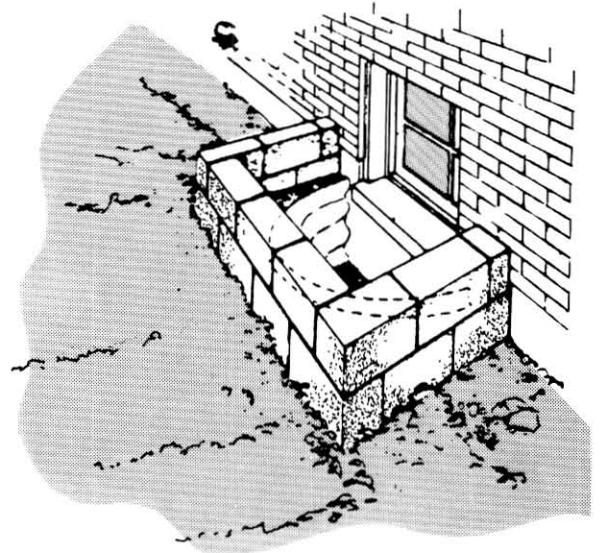


Figure 3-12

discussion of "access" under Levees and Floodwalls).

Dynamic Loads

Dynamic loads are shocks and pressures that may accompany a flood. Their effects on a building must be added to the static lateral load. Dynamic loads can be caused by wind, current, ice, and debris. The effect of a current moving slower than three feet per second is negligible.

Advantages of Dry Floodproofing

- * All contents of the house are kept dry.
- * If the flood depth is less than 2 feet, the measures to take could be simpler and cheaper than levees or floodwalls.

Problems of Dry Floodproofing

- * Sewer back-up must be prevented.
- * There will normally be no reduction of regular program insurance rates.
- * Dry floodproofing measures can fail or be overtopped by large floods. If this happens, the effect will be as if you had no protection at all.
- * Failure to properly estimate various loads could cause walls to collapse and/or floor to buckle.
- * Not applicable to wood frame houses without brick or masonry veneer.
- * Closing some openings may be dependent on human intervention.

Costs

- * Vary depending on flood heights and type of house.

- * Sealing walls.
- * Closures for openings.
- * Subsurface drainage.

WET FLOODPROOFING

Most of the expense and dangers involved in dry floodproofing are caused by the tremendous pressures which deep water will place on the structure. Wet floodproofing is the cheapest method to alleviate these dangers.

Wet floodproofing simply means making sure nothing would get hurt if you let the floodwaters into your house. Water on the inside that reaches the same level as the flood on the outside will equalize the pressures.

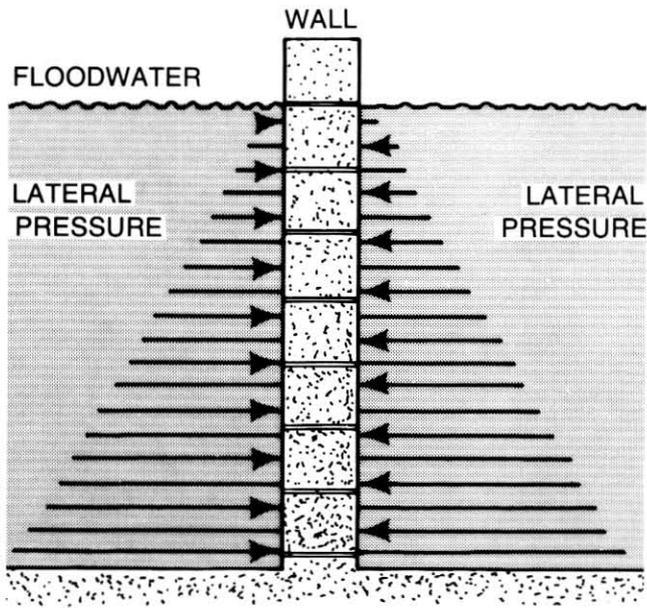
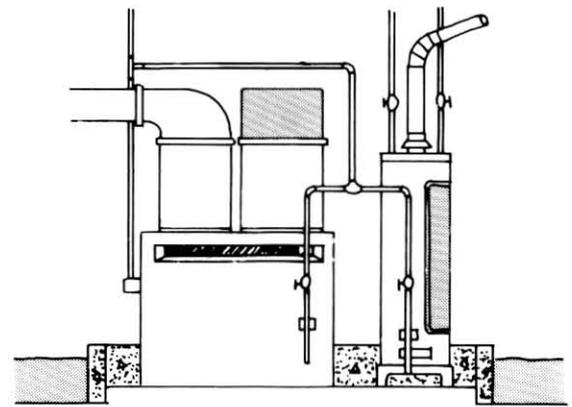


Figure 3-13

There are five parts to wet floodproofing your house. The first three deal with preparing the floodable area so water will not damage anything.

1. Remove hard to evacuate items that are subject to water damage. Freezers, washers, dryers, furniture, power tools, large appliances, and similar items should be permanently moved to higher floors.
2. Protect what cannot be moved. A floodwall or protection closet could be built around valuable, immovable equipment. Although such protection must deal with all the loads discussed in dry floodproofing, it would be cheaper to build a strong small wall than reinforce all your basement walls.

Another alternative is to place the equipment on a pedestal above the flood height. Some equipment can be protected by a coating of grease or covering with plastic bags or plastic sheets.



LOW FLOOD WALLS FOR SHALLOW FLOOD DEPTHS

Figure 3-14

3. Relocate or adjust your utilities. Either move all electric outlets above the flood level or install a control panel where the power can be shut off easily in time of flood. If your furnace, water heater, dryer and other gas appliances are not all elevated, make sure there is an accessible gas shut-off valve. The sewer and water systems should be sealed off to prevent health hazards that would be caused by interflows with flood waters. A water heater moved to an attic can act as an emergency storage tank for a gravity-fed potable water supply. Heating and air conditioning ducts should have "pop-out" holes or tape over holes along the bottom to permit water to drain out when the flood recedes.

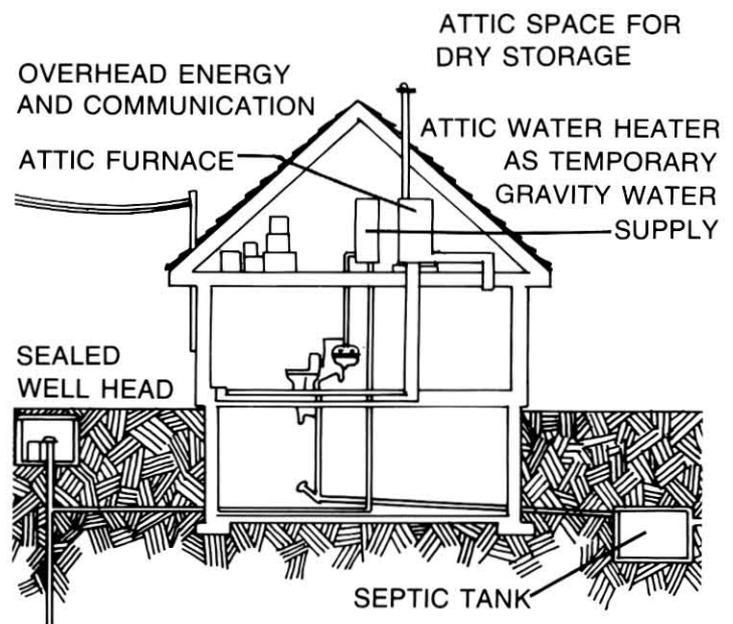


Figure 3-15

4. Let the water in. Make sure a doorway, window well, or inlet pipe will be open to let the water can reach all areas of your walls so they will be supported against outside flood waters.
5. Evacuation Plan: To wet floodproof a residential building, you must have adequate warning time to:
 - a. get people out of danger,
 - b. move any valuable items out of the area to be flooded, especially non-insurable items such as money, valuable papers, and vehicles.
 - c. turn off the utilities, and
 - d. let the water in; open the doors, windows, or valves on inlet pipes.

The Floodable Area

If the lower part of your house is made floodable, what can you still do there? If you have adequate warning time (at least 24 hours), you can leave a lot of easy to move furniture, tools, etc. in the floodable area. The less the warning time, the more your use of the area will have to be adjusted.

If your warning time is very short, you can do two things:

1. Use materials that won't be damaged: garden tools, metal furniture or cabinets, spare tires, boats or floatable items (if water is shallow), plastic curtains, etc.
2. Store things that are very quick to evacuate: vehicles, packed tool boxes, animals, etc.

If you rebuild or improve the floodable area, use the following types of materials:

concrete, concrete block, or glazed brick
 clay, concrete, or ceramic tile
 mastic, silicone, or polyurethane formed-in-place flooring
 terrazzo, rubber, vinyl or vinyl-asbestos floor covering with waterproof adhesives
 stone, slate, or cast stone (with waterproof mortar)
 glass or glass block
 metal doors and window frames
 foam or closed cell type insulation
 polyester-epoxy or other waterproof type paint
 indoor-outdoor carpeting (be able to remove it so the mud can be hosed out of it)

Certain materials should be avoided because they dissolve and decompose when wet or they absorb and retain too much water:

wood, chipboard
 gypsum products
 cork
 fabrics, carpeting, felt based floor coverings
 linoleum
 fiberboard, paperboard, strawboard
 batt, blanket, and other types of insulation
 wallpaper

Certain items should not be stored in the floodable

area because they would become especially hazardous or create health or pollution problems during a flood:

hazardous chemicals: chlorine, fluorine, acids, sulfur products, magnesium, many industrial chemicals

hazardous household products: lye (caustic soda creates deadly chlorine gas when mixed with water), pesticides, poisons, calcium hypochlorite (swimming pool chlorine), bleach, ammonia, lime, detergents charcoal, coal, coal dust, coke, and hay are subject to spontaneous combustion when wet or moist

gasoline, acetone, benzene

drugs, food (unless in tin cans)

storage tanks (inadequately anchored can float and cause damage to walls, ceilings, and other contents)

Finally, here is a list of products that are particularly subject to flood damage. They should be removed, if possible, from any flood-prone areas as an extra precaution:

appliances, clocks, and other electric motors
 art works, musical instruments
 books, magazines, papers
 clothing, curtains
 televisions, radios, electronic equipment
 upholstered furniture, mattresses
 cabinets, pool tables, and similar wood furniture that would become useless with only a little warping

Advantages of Wet Floodproofing

- * No matter how little you do, some wet floodproofing will reduce flood damages to your house and its contents.
- * No loads placed on your walls and floor.
- * No worry about sewer back-up.
- * Even if the flood heights are higher than your protection level, the results will not be as damaging as with other measures.

Problems with Wet Floodproofing

- * The evacuation plan will probably be dependent on human intervention.
- * No reduction in regular program flood insurance rates. However, if the floodable area was cleared out to such an extent that it would be declared "non-habitable", there could be a reduction in rates.
- * Your house will get wet inside and you will have to adjust to a new way of using the floodable area.

Costs

- * Rearranging utility systems (consult a contractor).
- * Labor to move things.
- * Flood insurance policy to cover items not moved or protected.
- * Clean up mud and water after flood.

PREVENTING SEWER BACK-UP

Although more common in communities that have a combined sanitary and storm sewer system, sewer back-up can occur where there are separate systems. It can be caused by two things:

1. The sewer lines on your property are broken, clogged with roots or debris, or directly connected to your roof or footing drains. When a heavy rain occurs, the lines cannot carry the additional water so it backs-up into your basement. If this is the cause of your flooded basement, you can fix the problem relatively easily. Contact a plumber or contractor.

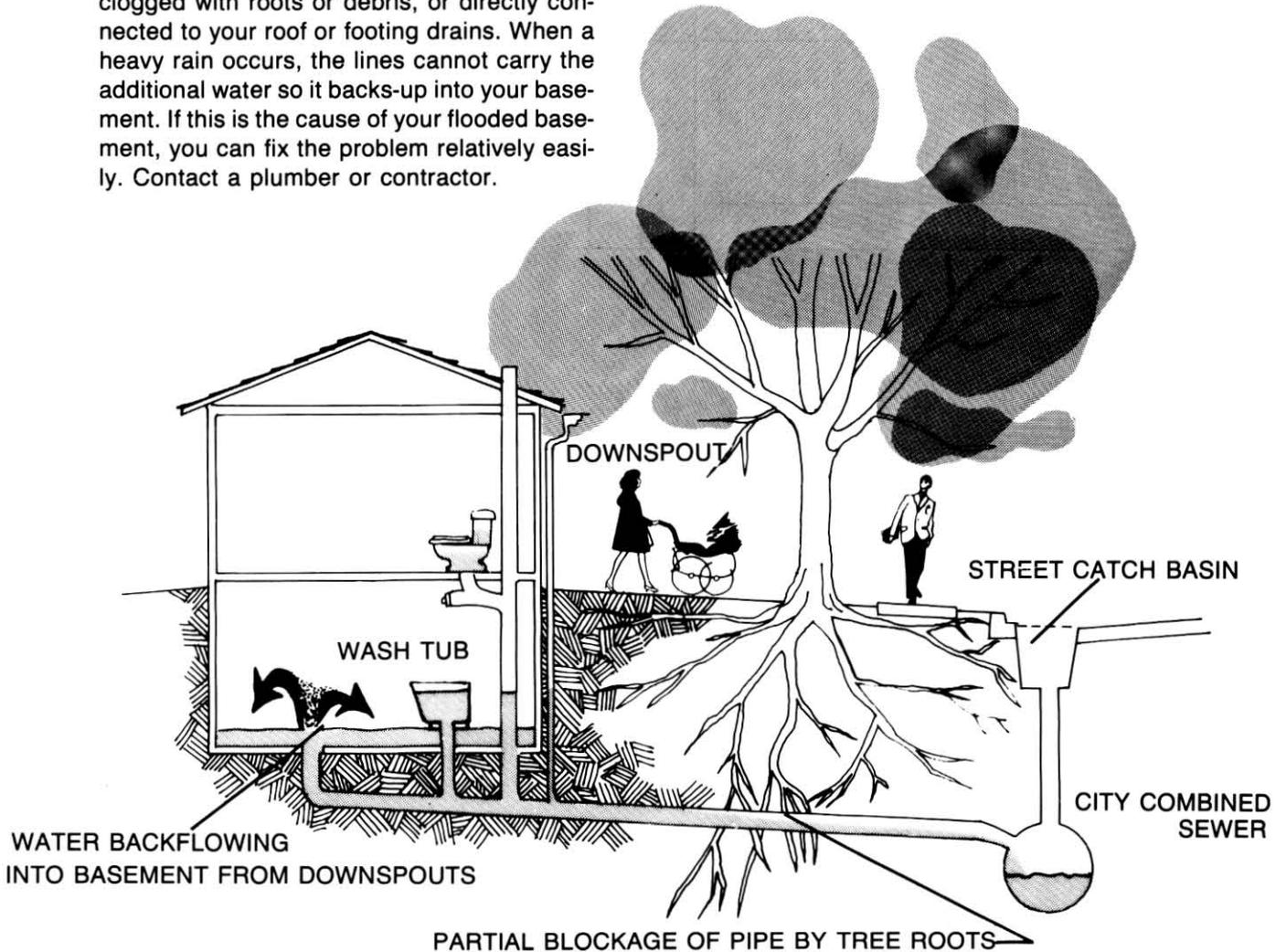


Figure 3-16

2. The sewer system cannot handle the extra water during a heavy rain or flood. Because of cross connections, inadequate design, too many new houses, or some other reason, the sewer mains become overloaded and back-up into your basement.

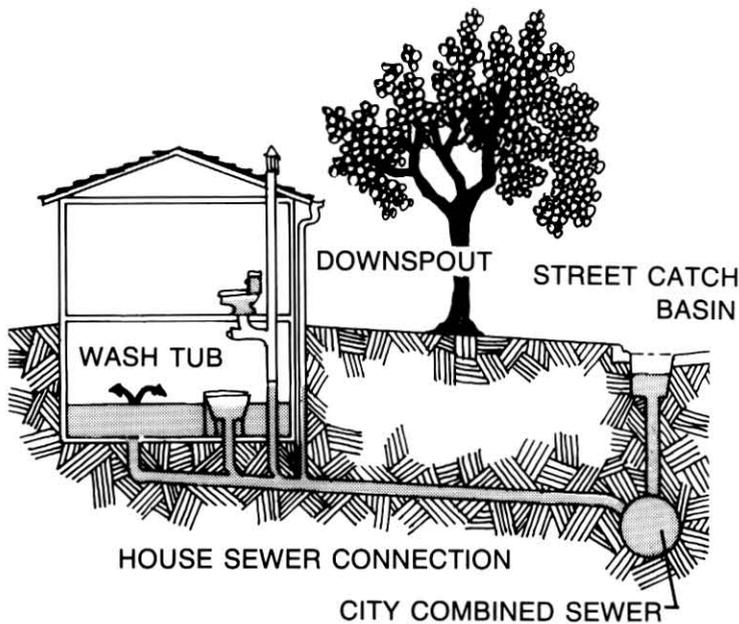


Figure 3-17

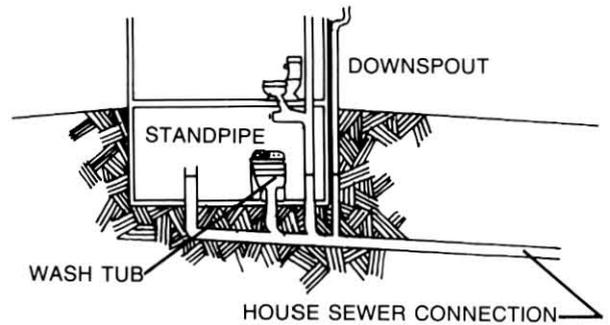


Figure 3-18

Valves

A back-up valve installed in the sewer line is more expensive but it will not permit the sewer to back-up into your basement. A valve should be placed outside your house where it would be easier to install and maintain. A valve can be manual or automatic.

If this is the cause of your sewer back up you can take either of two actions:

1. Let the sewer back-up and adjust your basement property so it is not damaged (see previous section on wet floodproofing).
2. Try to keep the sewer from backing up. The rest of this section will deal with this subject.

Plugs

Since the basement floor drain is the lowest point in your house, it is the first place of entry for backed-up sewers. The drain can be closed with a rubber or wooden plug during heavy rains. Some drains are threaded for a screw-in plug.

This is the simplest and cheapest way to stop sewer back-up. However, the sewer could back-up into the next higher opening, probably a sink drain or toilet. See also the discussion on pressures, below.

Standpipe

A pipe inserted or screwed into the floor drain will allow the sewer back-up to seek its own level. This method may be more dependable than a plug that could pop out. However, it has the same shortcomings as a plug.

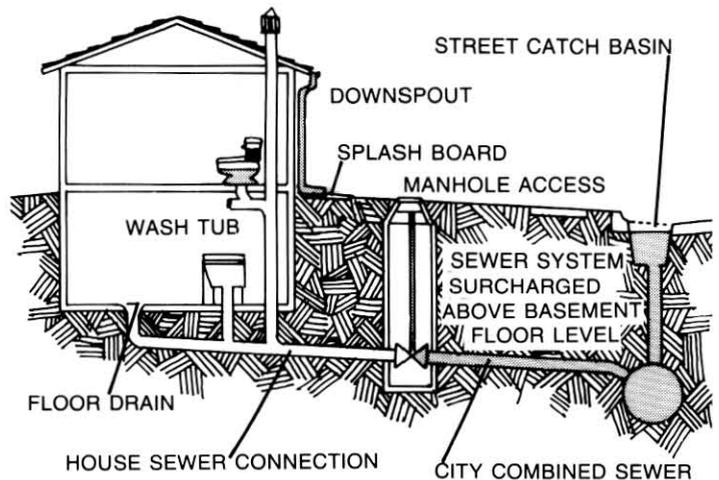


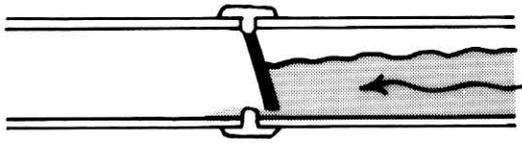
DIAGRAM FOR VALVE
(VALVE MAY SOMETIMES BE INSTALLED IN BASEMENT)

Figure 3-19

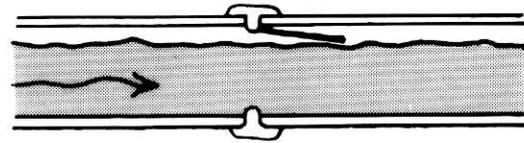
Valves can be jammed open by debris. This is less likely in a manual valve but manual valves have been known to "freeze up" if they are not turned periodically. Both types of valves should have a manhole or other access so they can be cleaned out or repaired.

A ONE-WAY CHECK VALVE

HOUSE DRAIN TO SEWER



ANY BACKUP FROM THE SEWER CAUSES THE VALVE TO CLOSE



FLOW FROM THE HOUSE CAUSES THE VALVE TO OPEN

Figure 3-20

Overhead Sewer

This is the most expensive but the most dependable and convenient method. Your sewer lines would have to be rebuilt so that all house sewage drains to a pump. Sewage is then pumped up to the height of the sewer system's manhole or inlets. From this height, it flows by gravity into the system. With this set up, the sewer system will back up onto the street before it could get high enough to back up into your house.

lbs/Ft² x 4 Ft = 250 pounds per square foot). The best way to deal with this pressure is to minimize the amount of sewer line exposed to the pressure. This could be done by installing a back-up valve near your property line. Of course, this merely transfers the problem to the city. Because of this, some communities prohibit back-up valves.

2. If the ground under your house becomes saturated, the water will push up on your basement floor. The effects of this uplift pressure and preventive measures were discussed under the dry floodproofing. A plug or standpipe are more likely to cause a crack in the line under your house. The newer the sewer line, the less likely it is to leak. You may want to permit the basement to flood a little to help equalize the pressures on your floor.

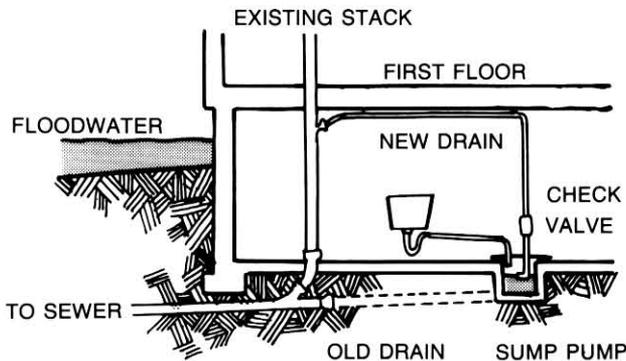


Figure 3-21

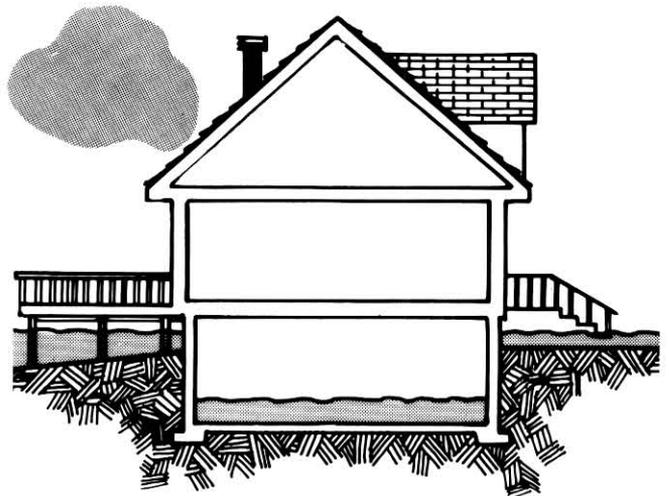


Figure 3-22

Pressures

If you use any of these methods, you should account for two types of water pressure:

1. Your sewer pipes are probably made of clay and were not designed to operate under pressure. Once they become filled up, a valve or plug could create enough pressure to break the pipe. A standpipe or overhead sewer will not relieve this pressure (the pressure at the bottom of a four foot column of water is 62.5

Advantages of Stopping Sewer Back-Up

- * Your basement will stay dry (assuming the flood waters do not get in through the walls or windows).
- * If water depths are less than a foot, they can be handled cheaply with a plug or standpipe.

Problems with Stopping Sewer Back-Up

- * Most of the methods require human intervention.
- * Overhead sewers require a pump that needs continuous power or a back-up system in case of power failure.
- * There will be no reduction of regular program insurance rates.
- * If the pressure is permitted to break the sewer lines, or buckle your floor, you may have a more expensive repair job than if your basement was allowed to flood.
- * Unless you install an overhead system, you cannot use your sewers during high waters.
- * Some methods may be prohibited by local ordinance.

Costs

Vary according to which method is used. Because the cheaper methods can cause greater pressures, consult a plumbing contractor.

SANDBAGGING

Sandbagging takes a lot of time and effort. It is not a preferred method when levees, gates, or flood shields are possible. Sandbagging may be appropriate if predicted flood heights will be higher than your levee or other protection.

Sometimes during flood emergencies sandbags can be obtained through your city or county emergency services office. They can be purchased if you want to stockpile them in advance. Check your Yellow Pages under "Bags" or contact your emergency services office for names of bag companies. You will want specially made sandbags, not plastic garbage bags or some other type that will not hold up.

Sandbags come in various sizes and materials. They should be 1' x 2' or larger. We recommend webbed polypropylene bags - burlap will deteriorate over time. The going rate is 25 to 40 each. Some companies may only accept orders of 1,000 or more. Also, some companies may sell you the sand.

The best filler is sand. Clay, sandy, or gravelly soil will also work. You will also need heavy plastic sheeting to provide for waterproofing.

Here are the steps to follow:

Number of Sandbags Required For 100 Feet of Wall	
Height	Number Needed
1 Foot	600
2 Feet	1,400
3 Feet	2,200

NOTE: We do not recommend making a sandbag wall over 3 feet high.

1. For proper support your wall needs to be 2½ to 3 feet wide at the bottom for every foot of height. Select your site and strip all the sod (when the grass gets wet it will be slippery; your wall could be pushed back by the pressure of the flood waters).
2. About ⅓ back from the flood side, dig a trench 1 foot wide by 6 inches deep. This is called a bonding trench and helps to keep the wall in place.
3. Fill the sand bags ½ to ¾ full. You do not need to tie them.
4. Lay the plastic sheet on the ground, one end in the trench, the remainder on the flood side.
5. Fill the bonding trench with the bottom of the bags pointed toward the flood and the unfilled portions toward your house.
6. The next layer of bags are laid parallel to the wall. The plastic sheet is kept one row of bags back from the flood side. The bottom of each bag is placed on top of the unfilled portion of the one next to it. The outside row and the row next to the plastic sheet have the unfilled portion tucked under.
7. Alternate direction of the bags as you build up. Tamp the bags tightly into place.

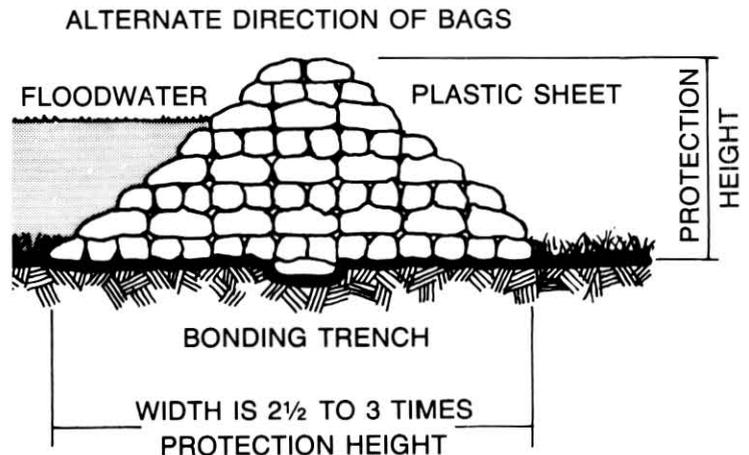


Figure 3-23

HUMAN INTERVENTION

Many of the protective measures discussed here depend on human intervention. This means that your house would not be protected unless some person closes an opening, installs a standpipe, or takes some other action. You can see that there could be problems. Four things should be considered before you select a measure that depends on human intervention:

1. Do you have adequate warning? Generally, the larger the river, the more warning you will get. On the Missouri, flood crest predictions are issued three or four weeks ahead of time. In other areas the waters rise before it stops raining.
2. Is someone always available to take the proper actions? Who will do it while you're away? If you're depending on a neighbor, will he have to cross a flooded ditch to get to your house? Will he be busy protecting his own house?
3. Can he/she do the job? Is he/she physically able to lift heavy gates or shields? Use special tools? Carry many items up stairs? Reach electrical panels 6½ feet high? Can he/she do the work outside during a raging storm? Is he/she experienced enough to do the job? Is he/she likely to get too excited under pressure?
4. Prepare a detailed written evacuation plan or checklist. Do not trust your memory during such a time of excitement. A written checklist is especially helpful if someone else is doing the job.

One final point: Don't prepare everything and then forget it. Equipment, valves, shields, supplies, etc., should be periodically checked. Don't pile things on top of the shields or sand bags being stored. The longer it takes for the next flood to come, the more likely you'll misplace or "borrow" a key item or you'll forget what to do. You may want to conduct drills, particularly for the benefit of others you may be depending upon.

STOCKPILING SUPPLIES

Here is a list of some items you may want to collect and keep in a safe place in case of a flood:

- * Sandbags, sand: Will you want to dig up your front yard? What if it's frozen or under a foot of snow? How about stockpiling sand in a new sandbox for your kids?
- * Plastic sheeting: Leftover sheets from painting drop cloths will be good for sealing around doors or plugging holes. Heavy sheets (at least 6 mil) should be purchased to make sandbag walls watertight.
- * Strongbox or waterproof box for valuable papers.

- * Things to take when you have to evacuate: flashlight, portable radio, spare batteries, first aid kit, rope, blankets, raincoats, camera.
- * Things to clean up with after the flood: shovels, mops, buckets, boots or waders, clothesline, bleach, soap, rags, garbage bags, tools.
- * Things for eating after the flood: (you may not be in danger of starving, but if the stores are damaged, food could be hard to obtain locally): drinking water containers (use ones with tight caps like empty milk jugs), canned food, emergency or camping cooking gear, water purification tablets (available at drug stores). Keep these items in the attic so there will be no contact with flood waters.

PAPERWORK

Relatives Insurance Agent
Emergency! Assistance!
Who to contact? Schools Information!
Fire State Local Officials Police

In addition to preparing your evacuation plan and stockpiling toiletpaper, there is some other paperwork that should be done. Do you have a list of emergency telephone numbers? Do you know how to contact your flood insurance agent? Do you have a copy of this handbook or other post-flood instructions? Are all these papers kept in a waterproof box?

WATCHES AND WARNINGS

Most of your protective measures will probably only work if you have some warning so you can put them into effect. There are two ways you can be warned:

1. You can watch the water yourself or set up your own early warning device;
2. You can listen for sirens, news announcements, or other government issued warnings.

Your Own System: If your flooding problem is caused by a small stream or sewer back-up, it is unlikely that a government agency will be watching the problem for you. There may be little time for such an agency to spread the word. In these situations, you may want to increase your preparation time by installing your own early warning device.

A simple device is to place a painted stick in or next to the stream as a warning gauge. A similar gauge painted inside a manhole can tell you when the sewers are likely to back-up into basements. If the gauge cannot be placed at a convenient location, neighbors can share the duty of watching it during or after heavy rains.

HIGHLIGHT WHERE WATER
WILL LEAVE BANKS
("GET READY")

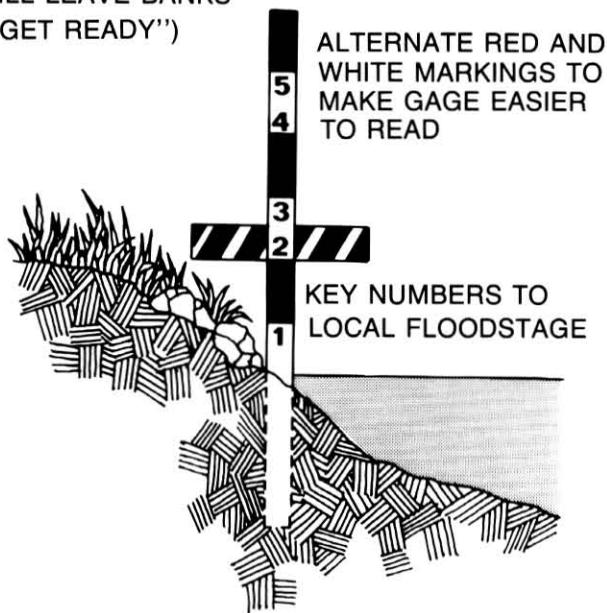


Figure 3-24

More remote warning systems are possible. You are really limited only by your imagination. We've heard of one man who gave himself 30 minutes of warning with a homemade contraption where a toilet bowl float set off a doorbell alarm in his house.

Government Warnings: The National Weather Service issues three types of notices on flooding.

1. **Long Range** Forecasts (1-3 weeks). These are based on snow melt predictions and are meant as general notices for you to think about getting ready.
2. **Flood Warnings.** As a flood proceeds downstream, gauges report heights to central offices. Numerous agencies predict when and where a river will leave its banks. Residents and local officials can be given several hours to several days advance notice of how high the flood can be expected to go ("crest"). The bigger the river, the more accurate the prediction and the more warning time there is.
3. **Flash Flood Watches and Warnings.** Along the smaller streams, floods are caused by heavy local rains. In steep mountainous areas, the rain runs off very fast. Little streams are converted into raging torrents with great destructive potential. While there are not many mountainous areas in Nebraska, flash floods do occur along bluff lines **and in urban areas**. In urban areas, rain quickly runs off roofs, parking lots, and streets. Gutters and storm sewers hasten this water to the rivers. Heavy rains do

create flash flood conditions in many urban areas of Nebraska. You may not get a raging torrent but waters will rise quickly. To deal with flash floods, the Weather Service issues flash flood watches when ground and rain conditions threaten urban and mountainous areas. If radar, rain gauges, and local observers report that a flash flood is very likely or is occurring, a flash flood warning is issued. Your city may also sound a siren or other local warning. You should check with your city hall to see what system is used.

A FLASH FLOOD WATCH MEANS CHECK YOUR PROTECTION SYSTEMS, KEEP INFORMED, AND BE READY FOR IMMEDIATE ACTION IF A FLASH FLOOD WARNING IS RELEASED.

A FLASH FLOOD WARNING MEANS TAKE IMMEDIATE ACTION IF YOU ARE IN A FLOODPLAIN: IMPLEMENT YOUR EVACUATION PLAN.

Reacting to the Warning

Whether you have several weeks or only a few minutes after the warning is issued, you should be prepared to react. The next section deals with specific steps that should be taken. We want to underline an important point here: The biggest problem in issuing warnings of danger is that people do not react. Here are some common responses:

"The last warning proved false, why believe this one?"

"I've never seen a flood here before."

"What does a watch or a warning mean?"

"No one else looks worried, I'll try not to."

"I better get down to the creek and see for myself."

Studies have shown that when people are given conflicting reports, they almost always believe the one that says there is no problem. Here are some things to keep in mind:

1. Go to city hall and check your local flood map. It was prepared to inform you of the more dangerous but less frequent floods that could occur. It is a more dependable notice than a neighbor who hasn't seen a flood in the last ten years. If you are in the flood plain, those watches and warnings apply to you.
2. Do not try to go down to the creek and see if a flash flood is coming. You will lose valuable time and you may not make it back.
3. See the previous page for what a watch and warning mean.
4. In spite of all the money and modern technology that goes into the Weather Service's warnings, many flood predictions will not be 100% perfect. Do you know in advance which ones will be wrong? What do you lose if you implement your evacuation plan? What do you lose if you don't and the flood comes? Isn't it worth it even as a drill?

EVACUATION PLANNING

An evacuation plan is simply a plan to get everything and everyone out of danger after you receive the flood warning. You should prepare a plan for your house so that nothing will be forgotten when the time comes. An evacuation plan should be in two stages, one to get ready and one to implement.

Preparation

This stage should be initiated when a flash flood watch is issued or when the flood stage reaches a certain level. Here are some things that could be included at this stage:

- * Check flashlight and radio batteries.
- * Test manual valves.
- * Fill drinking water containers.
- * Put sandbags, shovel, buckets, etc. near the door.
- * Put toolbox, valuable papers, extra clothes, blankets, first aid kit, critical medicine, flashlight, radio, etc. in the car.
- * Test sump pump and back up power supply.
- * Fill car with gas (if the area loses power, the gas station pumps won't work).
- * Begin filling sandbags.
- * Station someone at the neighborhood gage.
- * Station people at selected bridges to prevent debris jams.

Activation

This stage is when you carry out the protective measures. It would come after a flash flood warning or when the water almost reaches your house. In flash flood areas your plan may have to be limited to what you can do in 60 seconds. Whether you should evacuate the people out of your house depends on your particular flooding situation. Here are some ideas for what your plan could include at the activation stage:

- * Close levee/floodwall/dry floodproofing openings.
- * Close sewer back-up valve/put plug or standpipe in.
- * Close internal drainage valve in levee or floodwall.
- * Open wet floodproofing openings to let water in (your plan should list all of them so they are not forgotten).
- * Move selected furniture, appliances, hazardous materials, etc. up to the second floor (your plan should list which ones are to be moved first).

NOTE: If you have enough warning, you may want to get a truck and move all your furniture to high ground. This type of expense can be reimbursed with an NFIP flood insurance policy.

- * Turn off electricity, gas, water (your plan should show where the switches and valves are).
- * Lock up the house and drive/walk to high ground (your plan should include a map and you should know where public shelters are).

Safety Tips

Remember, the safety of you and your family is much more important than protecting your furniture and appliances. Here are some things to keep in mind:

- * If you have dry floodproofed your house, stay out of the basement. As discussed earlier, your walls may not be strong enough and they could collapse.
- * When flood depths are over two feet, your access is cut off. Before this happens, move children, handicapped and others to high ground and safety.
- * Do not try to drive across a flooded road. If your car stalls, leave it. Many people drown trying to rescue their car.
- * Do not try to walk across a flowing area where the water is above your knees.
- * Stay tuned to the radio and keep on the lookout for a second crest.
- * Keep your family together. Everyone should carry identification.
- * Obey police, civil defense workers and warning signs.

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SECTION 4

EMERGENCY ACTIONS

Actions taken immediately before a flood can lessen damage to your home and personal property. Radio and television stations, newspapers, and police and fire department personnel provide warnings about possible flooding in low-lying areas. It is imperative that you know the level of your property in relation to the river flood stages if you live in an area subject to flooding. Thus, when flood predictions are for a certain flood stage, you will know whether your property is above or below that level. If you live below the flood level, you will have an idea how high the water will be in your home and what actions you will have to take to lessen damage to your property.

In the event of a flash flood warning, immediate action is necessary to save yourself and your family. Know in advance the route you will take to avoid the flood waters, for they are unpredictable and deadly.

If you have to evacuate your home, there are certain essential items you should take with you that can be used during and after the flood. Pack these in your car to be ready to go when you do.

PACKING LIST OF ESSENTIAL ITEMS

If you have received a flood warning, stock your car with emergency supplies to be evacuated with you. These might include:

- * Special medications or dietary foods
- * Eyeglasses
- * Hearing aid batteries
- * First-aid supplies
- * Baby formulas and supplies
- * Supply of non-perishable food
- * Pet food
- * Water purification tablets or 5.25% sodium hypochlorite liquid laundry bleach for purifying drinking water
- * Sanitary and toilet supplies
- * Flashlight, batteries, and bulbs
- * Battery operated portable radio
- * Tools - shovel, hammer, pliers, screw driver, axe
- * Blankets

- * Dry clothing (especially shoes and socks)
- * Rubber boots, gloves, and hard hat
- * Important papers
- * Bank books and check book
- * Valuables and cherished articles (jewelry), pictures
- * Games for group play for children and adults

Warnings for floods, not flash floods, usually give the height of the crest and the approximate time of its arrival, but flooding might start some time before the crest is reached. If time permits, there are several actions you can take to lessen flood damage to your home and to minimize post flood health hazards to you and your family. Some of these actions can be found on the following pages.

UTILITY SHUTOFF

Electrical System

The flow of electricity through your home is controlled by either plug fuses (Figure 4-1) or circuit breakers (Figure 4-2) located within a panelboard mounted on the wall.

Plug Fuse Box

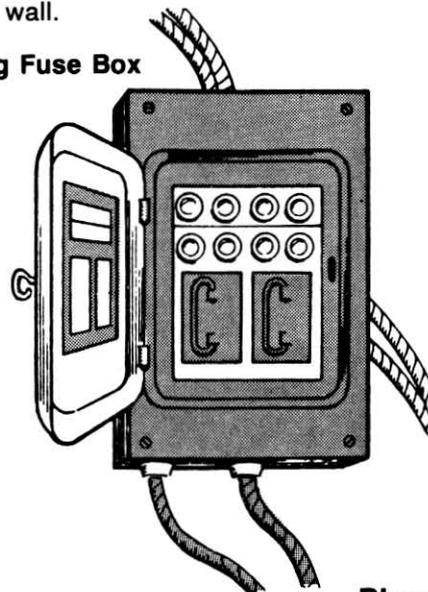


Figure 4-1
Plug Fuse Box

Circuit Breaker Box

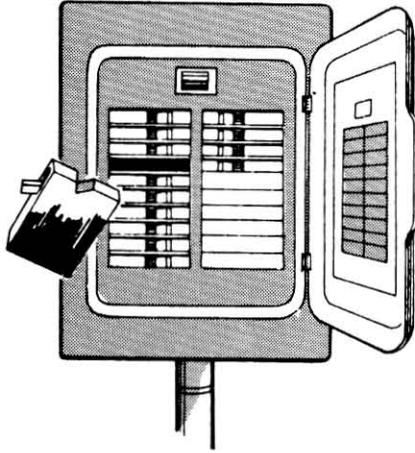


Figure 4-2

Open the panelboard door on your circuit breaker box and identify what part of the system each plug fuse or circuit breaker controls. This information may be on the back of the panelboard door already. If it isn't available, experiment by removing each fuse or switching to OFF each circuit breaker one at a time. Then determine which lights, appliances, and outlets are controlled by that fuse or circuit breaker. Write this information on a sheet of paper to take with you when you evacuate or put it in a place above the anticipated flood water level. Replace the fuse or switch the circuit breaker back to ON, and repeat the process until the entire electrical system of your home has been checked. **CAUTION:** Some appliances contain compressors (air conditioners, refrigerators, freezers) that may have to rest a short time (5 minutes) before being turned on again to avoid blowing the fuse or opening the circuit.

If flooding is imminent, remove (don't just loosen) all fuses, including the one at the main switch and at the range switch, and put them in a place above the anticipated flood water level. This will minimize the danger of short circuits when the power company returns service to your home after the flood.

If you have a circuit breaker panelboard, switch each circuit breaker to the OFF position.

Gas

Close main gas valve. This valve is generally located on the gas piping just prior to its entry into the gas meter.

Water

Close main water valve. It usually is found on an exterior wall or on the floor of the lowest level of your home where the water supply enters.

Drinking water can be stored in a clean and covered bathtub or in the hot water tank. If the hot water tank valves are turned off and no heat is supplied to the tank, flood water cannot enter the tank.

GENERAL ACTIONS

Anchor fuel tanks to prevent them from overturning or floating. Close fuel tank valves to prevent leaks, spills and flood water infiltration.

Move as many household items as possible to as high a place as possible. Place furniture on beds and then personal items on the furniture. Also, items could be placed on the roof and covered with polyethylene sheet stapled in place using thin strips of wood or heavy cardboard. **CAUTION:** Your roof or upper floor may not be able to safely support the additional weight of heavy equipment or furniture.

Include cardboard boxes and newspapers as items to be moved to higher ground. Such material will disintegrate and clog drains when flood waters recede.

Anchor, secure, or weigh-down any items that may become debris or battering rams in moving water; for example, tie furniture and personal items on top of a bed to the bed and then anchor the bed by tying it to the house structure.

Remove all wood drawers, even though empty, from built-ins (e.g., cabinets) and furniture (e.g., dressers) because wood swells when wet and the resulting pressure between the drawers and their containers can damage wood fibers.

Remove lightbulbs from permanently mounted light fixtures below flood level to prevent their breakage. Put the lightbulbs and other glass items in plastic bags to prevent glass from shattering and spreading if the item is broken.

Protect valuable machinery and equipment that cannot be relocated by enclosing them in waterproof covers (Figure 4-3), or by coating them with water-repellent grease to minimize damage and to facilitate cleaning and return to operation (if practical, consider encircling such equipment with a wall of sandbags.).

Relocate chemicals that react with water to give off heat or form explosive or toxic gases and chemicals such as weed killers and potassium to the highest level in your home and ensure that they are in waterproof containers. This will prevent safety hazards, pollution, or damage to materials in your home.

Remove and dispose of perishable food items in cabinets, refrigerators, and indoor trash cans or place in plastic bags or containers and seal shut. Tie shut and anchor outdoor garbage cans to minimize spread of disease and unsanitary conditions. Tie down loose items in the yard to prevent them from being carried away by flood water or battered against other items or structures.

If you have a boat, move it in such a way that you can gain access to it easily during the flood.

PREPARING THE STRUCTURE

Only a qualified structural engineer can tell you whether your basement can or cannot withstand anticipated flood-water levels.

Allow Water Into Basements

If a structural engineer has not checked your house to determine its structural soundness or has determined your house to be structurally incapable of withstanding the added forces created by the buildup of flood waters on the outside, the following actions should be taken:

Open all windows, prop open all doors to the outside, to rooms and closets, and to the garage to allow water to enter unimpeded. Equal pressure inside and outside lessens the chance of structural damage to your home from hydrostatic pressure and prevents it from lifting off its foundation or tipping over in most cases. You can knock small holes in your concrete block basement walls about 1 foot above ground level to allow water to fill the basement and equalize interior and exterior pressure. Use a hammer and cold chisel. The cold chisel should be longer than the block is wide. Holes can be patched after the flood has passed. Running tap water into the basement is slower, but if there is time, this is preferred as it is cleaner. Cover the glass of open windows with cardboard or heavy plastic to prevent the glass from shattering and spreading. Do not obstruct the window openings or prevent water from passing.

Keep Water Out of Basements

If a qualified structural engineer has determined your house to be capable of withstanding anticipated flood-water depths, the following actions can be taken:

Close all windows and doors and cover them with polyethylene sheet and boards, plywood or previously-fitted closure panels. Place sandbags and/or shoveled dirt in front of doorways and the more vulnerable areas of your home to keep the water away from them. Sandbags can be made with burlap or other strong material that will not dissolve in water or break when being carried. They can be filled with sand or dirt. You can also keep flood waters away from your house by surrounding it with a temporary levee. If you have a sump pump, check it to be sure it is operating properly.

SEWER AND DRAINAGE LINES

Flooding of a home as a result of back-up through sewer and drainage lines is a problem for buildings located in flood plains. Sewer back-up can flood the basement and even the upper floors with raw sewage. Back-up is caused by flood waters over-loading sewer lines to the extent that they can no longer carry off the

sewage by gravity flow. Sewage in the lines then seeks its new level which may be above the level of household drains. Backflow pressure reverses normal flow and raw sewage runs from floor drains, toilets, tubs, sinks, basins, and appliances.

To avoid this backflow of sewage, it is necessary to close off all of these entries into the house. Many of these are difficult to close. For example, stopping the wash basin drain does not stop the basin overflow from carrying backflow into the house. The basin, therefore, must be plugged at the trap fitting. This could be done by removing the trap from under the basin and plugging the sewer side of the drain pipe. A more effective method, however, is to install a backflow valve on the main sewer outlet line as described in Section 6.

APPLIANCES

Disconnect and store small, transportable appliances (toasters, blenders, percolators, and other electrical devices) at the highest possible level (e.g., second floor or attic). If possible and if time permits, wrap these appliances and others in plastic and tie as shown in Figure 4-3 (for a large appliance).

Sealing Appliances

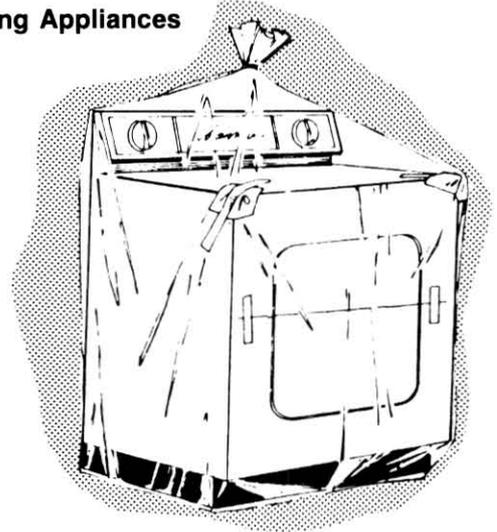


Figure 4-3

Seal openings of the large appliances with wide tape such as masking or waterproof adhesive tape (be liberal), tie shut, and anchor the appliances to prevent buoyancy and thus their damaging themselves and surroundings. If you are not able to anchor these appliances, leave them open to allow water into the interior to prevent buoyancy. **NOTE:** Top-loading dishwashers and clothes washers should first be filled and weighted down with clean water to prevent buoyancy. Dryers can be weighted down with sandbags. Freezers can be weighted down with food and then sealed and anchored.

Disconnect heavy, unmovable appliances because when the electrical service is being returned to your home after a flood, all appliances must be disconnected to facilitate determining whether any electrical problems are the fault of the electrical distribution system or an appliance. Due to water debris or wreckage, getting to electrical outlets to disconnect appliances after a flood may be difficult as well as dangerous.

Remove, if time and manpower permit, electrical motors from washers and dryers (those from dishwashers are usually difficult to remove due to their integral attachment to the pump), seal in plastic bags, and take to a higher level with small appliances. Motors are sensitive to water and are expensive to recondition. If a sump pump is used in the basement, remove and store it in a safe, dry place above anticipated flood level. This will make the pump available when you return for use in pumping out any water remaining in the basement.

If you have a second floor that is expected to stay dry, carry as many belongings as possible upstairs, but be careful not to overload it.

If flood water is expected to rise above table height on your first floor, prop open all doors to all rooms and to the outside and open all windows to allow water to flow freely throughout your home. An equal water level inside and outside will cancel hydrostatic pressure on the walls and floors and lessen chances of major structural damage on your home. A house so filled with water is not likely to lift off its foundation or tip over.

SECTION 5

AFTER THE FLOOD

SAFETY PRECAUTIONS

Before Entering a Flooded Area

If possible, wait until authorities have declared the area safe before entering a flood zone. Before entering your house, wait until it has been checked for safety and water has been pumped out if this would not result in undue delay.

Wear high leak-proof rubber boots (or at least rubber-soled shoes) and, if available, thick rubber or dry leather gloves, and a hard hat when you are in a flooded area.

When you are going into an isolated area tell someone who will notify the proper authorities if you do not report back.

Check with the electric power and gas companies to determine whether the power and gas were shut off and whether they are still off. If you are served by a central water supply, find out if the water is contaminated. If your water comes from a private well, determine whether the well was flooded. If so, it can be considered contaminated.

After Entering a Flooded Area

Indoors or out, under flooded or damaged conditions, treat every electrical item with the greatest respect. **EVERY SOURCE OF ELECTRICITY CAN BE EXTREMELY DANGEROUS UNDER FLOOD CONDITIONS.**

If traveling on foot through a flood zone, observe overhead electrical lines for broken wires or evidence of arcing. Avoid the vicinity of power lines if possible, and cross under them only at midlength between supporting poles, if you must cross them.

An energized electrical utility wire or a utility pole partially or totally submerged in water - whether metal or wet wood - can create an electrical field in the water that will cause a serious electrical shock hazard. If water remains on the ground, heed the following safety precautions.

If utility wires are underwater, maintain a maximum distance from both utility poles and wires. In no case approach closer than 20 feet; and for high-voltage

transmission or feeder lines, no closer than 50 feet. If the utility wires are not broken or under water, stay at least 10 feet away from the poles.

If you are in a metal boat, keep a similar distance from utility wires and poles. If you are in a wooden or fiberglass boat, do not touch the water or metallic parts of the motor when near utility wires or poles. Utility wires laying in the water will normally be dead, due to blown circuit breakers. It is safer, however, to consider any grounded wire as being dangerous.

Keep the boat away from guy wires. Metal of the boat or its engine touching a metal guy wire on a utility pole can arc causing a spark that may ignite any oil or gasoline on the water's surface.

Ground the outboard motor to the metal hull of the boat by running a wire from the grounded battery post to a bolt in the hull. This grounds the battery to the boat, avoids possible ignition of gasoline in the boat, and eliminates an electrical shock hazard to those in the boat.

Do not smoke. Flammable liquids may have contaminated the water.

Entering Your Flooded Home

If you must enter your home before it is inspected for safety by either local or Federal authorities, walk around its perimeter and, starting from the bottom, inspect it for signs of undermining, cave-ins, shifting, or collapse. If the building appears sound, enter it carefully. If there is evidence of significant undermining or settling, do not enter the home until it has been inspected by local or Federal authorities.

If the house or a porch rests on exposed foundations with accumulated debris underneath, be careful upon removal of the debris that the foundation's support is not thereby undermined.

If material supporting the foundation is washed away but the foundation is not damaged, the underlying material can be replaced with well compacted crushed rock or gravel, a concrete footing, and a masonry or concrete wall to support the foundation.

If parts of the footing or foundation have settled or cracked, those parts may have to be reinforced or

replaced. Foundation settling or cracking may result in uneven floors or misalignment of door and window frames. Use only concrete, masonry, or both to reinforce or replace settled or cracked foundations, never earth, gravel, or crushed rock.

If part of the foundation has collapsed, it can be temporarily supported with timber shoring and jacks as shown in figures 5-1, 5-2, and 5-3.

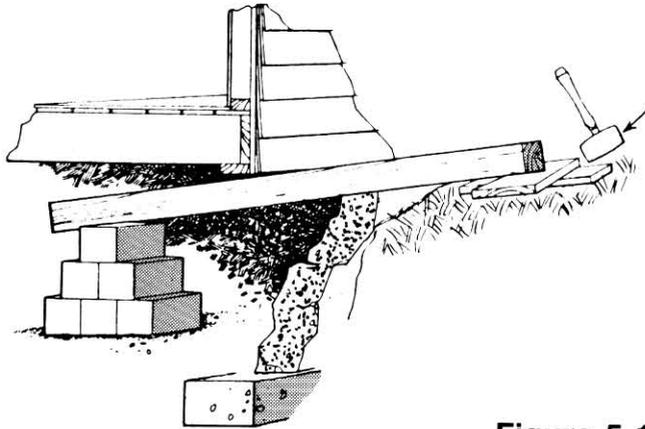


Figure 5-1
Temporary Support

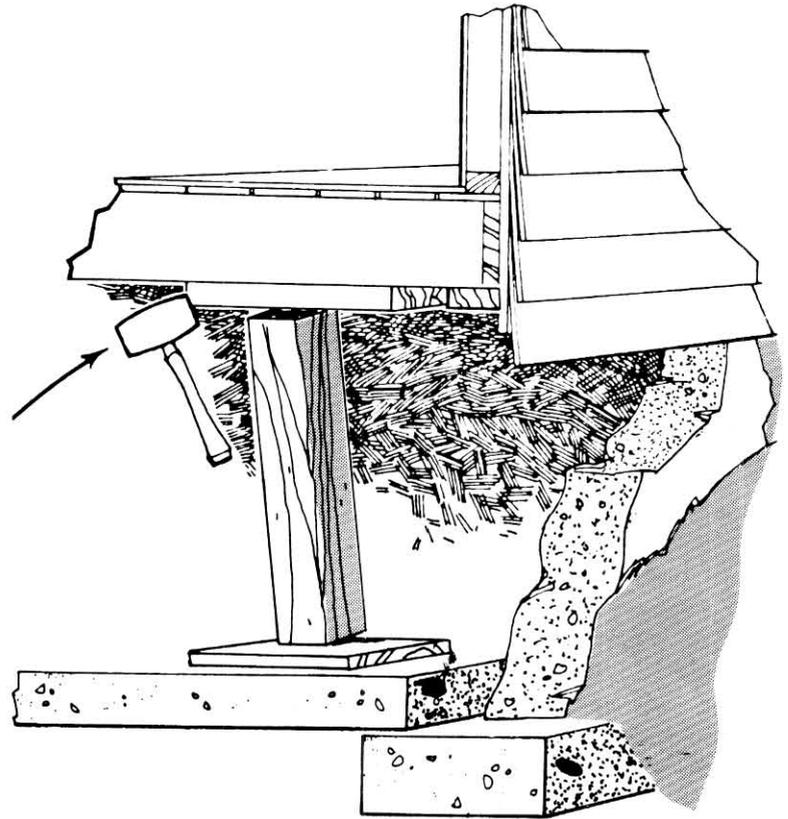


Figure 5-3
Temporary Support

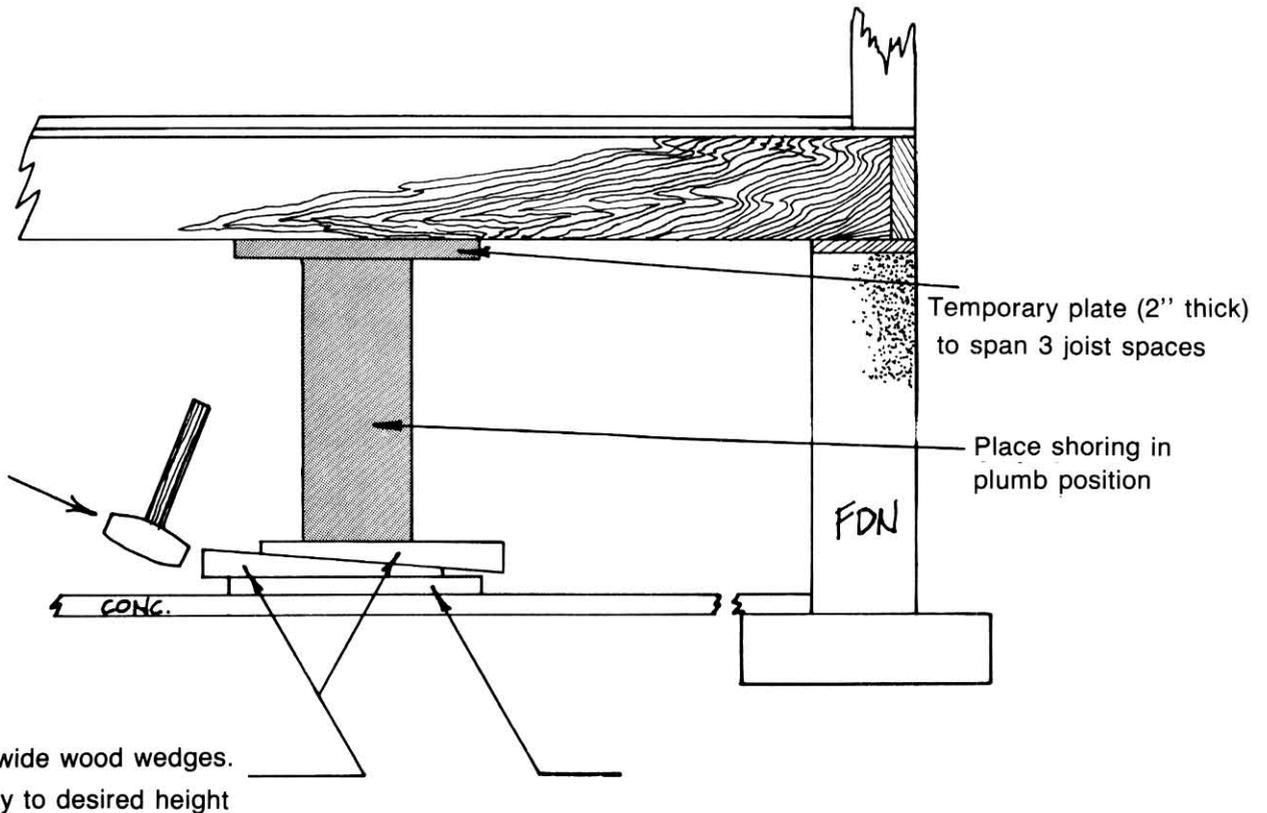


Figure 5-2
Temporary Support

Move around slowly and carry a flashlight as you inspect for structural damage. Flooring and stairways should get particular attention. Watch for loose floor boards, holes in the floor, protruding nails, and sagging ceiling areas that may be ready to fall. Wet plaster and drywall are heavy and dangerous; if loose, use a broom stick or any other long handled device to break it down before doing any work. But watch out - a sagging ceiling may contain a surprising quantity of water. **Do not smoke or use open flames** as escaping gas may have collected in pockets of the building.

There is a very real prospect of death within a flooded home containing energized wiring. Do not turn on any lights or appliances until a qualified electrician has checked the entire electrical distribution system.

If you did not turn off the main electrical switch before the flood, have an electrical service man turn it off now. You can turn it off yourself upon entering the house, but **USE EXTREME CAUTION!** The electric company may have turned off electrical power in your home, but they could turn it on again without your knowledge. If the main switch is damp or if the floor is wet, use the following precautions:

- * Stand on a dry wooden ladder or stool.
- * Wear high rubber boots free of cracks or pin holes.
- * Wear thick rubber gloves or dry leather gloves.
- * Wear dry clothes.
- * Have your hands and arms dry.
- * If practical, use a dry wooden or plastic rod to operate the switch.
- * Do not use any material that contains metal.
- * Do not wrap your hand or finger around electrical equipment. Use the back of your hand or knuckles to contact the handle when touching it.

Electrical power should not be restored to a house that has been flooded until the electrical distribution system has been checked by a knowledgeable electrician.

Do not enter a room where water is covering an electrical outlet or where a loose wire is hanging in water, even if you removed fuses from the panelboard or switched off the circuit breaker before the flood. Water impurities and mud can cause circuits to be energized. It is possible for an electrical field to exist in the water.

Do not touch a wet wall or baseboard near electric outlets. They might conduct an electric current even if the fuses were removed or you switched off the circuit breaker if a circuit has been completed due to impurities in the water or mud deposits.

If the area has been flooded, stay away from appliances such as clothes washers, dryers, electric stoves, and sump pumps unless you pulled their plugs prior to the flood.

Do not pull appliance plugs in a flooded area unless the house's main disconnect switch is known to be turned off and dry.

If you did not turn off the gas at the meter or tank prior to the flood, do it now. The gas company may have discontinued service, but it can reestablish service when you are unaware of it.

HEALTH PRECAUTIONS

Drinking Water

If there is any chance of flood contamination of your drinking water, drink only purified water until the normal water supply has been certified potable by health authorities. Municipal water systems as well as private wells are subject to flood contamination, and local health officers should be prepared to certify water sources.

If potable water has not been stored, available water may be purified by several methods:

1. Mobile water purifying units (usually borrowed from the military forces) provide a community source of drinking water.
2. Iodine may be used according to instructions or chlorine can be used as described below for purifying emergency water supplies.
3. Wells that have been flooded are considered contaminated and should be decontaminated as described later.

If facilities are not available for boiling drinking water, you may purify it as follows:

Add 1 teaspoon liquid chlorine laundry bleach to 5 gallons of water. (Make certain that the label specifies 5.25 percent sodium hypochlorite solution with no additional active ingredients.) Or use 4 drops of solution per quart of water. Mix well. Let stand for 30 minutes before drinking. After the 30-minute waiting period, a small amount of vitamin C can be added to reduce the residual chlorine taste.

Food

Discard all foods exposed to flood water except those in hermetically sealed (airtight) metal cans. Permanently mark the cans to keep their contents identifiable, remove paper labels, and wash the cans in soap and warm water. Then immerse in a solution of $\frac{3}{4}$ cup of 5.25 percent sodium hypochlorite household laundry bleach per gallon of water for 2 minutes to disinfect the outside of cans. Rinse immediately in clear water. The chlorine solution may discolor some metal cans. Do not treat aluminum cans, such as soft drink cans, with chlorine solution.

If flood water did not enter your freezer and your freezer is fairly full, the food may have survived a 2- or 3-day period (given the lack of electrical power) without much loss of quality and flavor. Discard meat,

poultry, and fish if there is any sign of spoilage. Cook completely thawed meat - large quantities then can be refrozen. Refreeze fruits and vegetables that are still firm.

Wash your hands thoroughly (with a disinfectant soap if possible) after handling contaminated articles. To be on the safe side, consider all items exposed to flood waters contaminated.

Wait until your home and belongings have been thoroughly cleaned and dried before deciding whether to discard or tear out. They may return to "as good as new" condition or at least be repairable. Much can be salvaged if immediate, proper restoration steps are taken as described hereafter.

HOUSE INSPECTION AND RESTORATION

Clean up and repair actions described in this section account for flood levels ranging from some water in the basement to water up to the roof. You can do the work in some cases. In other cases, skilled workers are required. Immediate action following a flood will lessen damages to certain items. Drying out the home, for instance, will lessen chances of delamination, warpage, rust, etc. If repair services are available, water damage to household appliances may be less than major. A great deal depends on weather conditions, temperature, and relative humidity after the flood.

The first step is to inspect the house exterior for damage.

Improvise temporary repairs to roof caused by wind and water. Use materials at hand, such as asphalt coated roofing paper, 4- or 6-mil polyethylene sheeting, tarpaulins, etc., to minimize rain damage and provide weather-resistant quarters for the family.

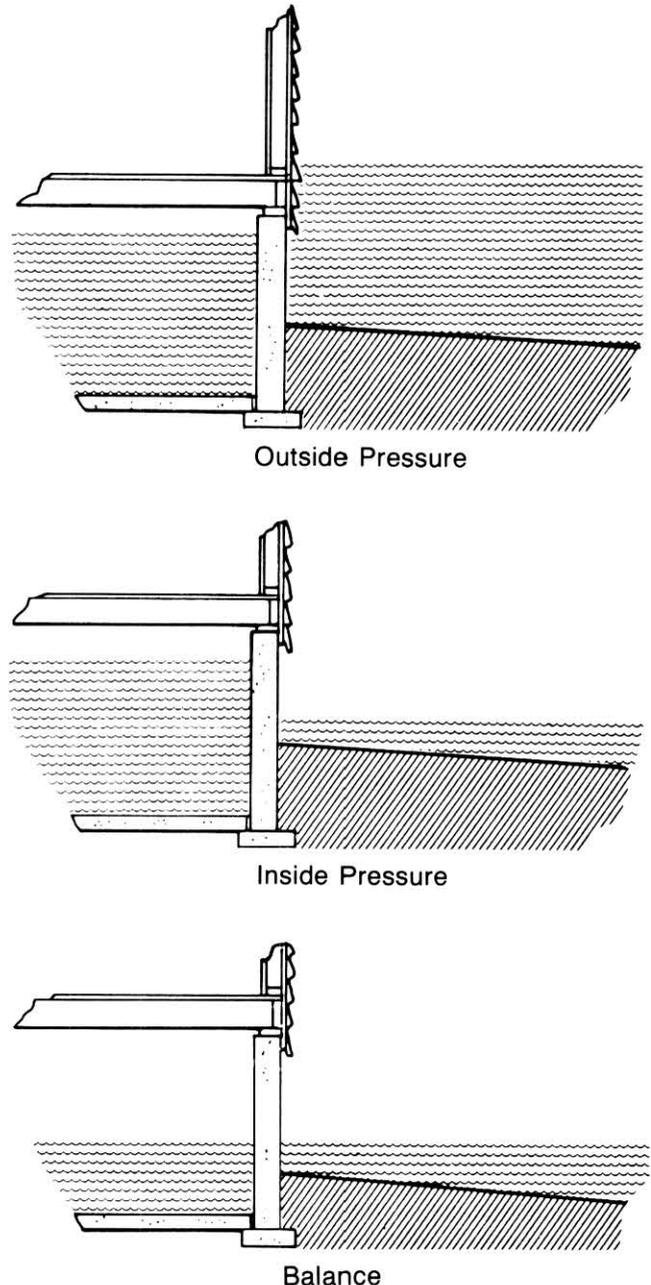
If chimneys are structurally sound, clean out any flood debris before lighting a fire.

Draining Your Basement

If local or Federal authorities have not had your basement drained, proceed according to the following instructions. Remember, however, you should be wearing high rubber boots free of leaks and pinholes, and thick rubber or dry leather shoes. If your electrical panel-board is located in an area that was flooded, you will be unable to use an electric sump pump and will have to use a gasoline driven pump, a 12-volt auto battery driven pump, or a rubber or plastic pail to drain your basement.

Basements flooded with surface water, seepage through walls, or backflow from sewer lines often suffer little or no structural damage from in-flowing water. This is true because the water inside braces the walls against the pressure of outside water and waterlogged soil. Do not remove the water in your basement until most of the water pressure on the outside of the walls

has been relieved to prevent the walls from being pushed in or the floors from heaving. Figure 5-4 and the following paragraphs discuss the amount of relative pressure upon the basement walls and floor under various conditions.



(Soil Pressures Not Shown)

Figure 5-4
Water Pressures on Basement Walls

Do not remove water above ground level in your basement until the subsiding flood water outside is equal to the basement water level or a bit less.

Start pumping water out of your basement immediately if it is above ground level and higher than the flood-water level on the outside. Stop pumping when the two levels become equal.

Once flood-water and basement water levels are equal, pump the basement water out at approximately the same rate at which the flood waters are receding.

When water in the basement is level with the ground level and all flood waters have receded, continue to pump very slowly, as seepage, a little at a time, through the walls may help relieve the pressure on the outside of the wall.

And, for the same reasons, if water in the basement is below ground level (which would be the case for basements built entirely underground), do not begin pumping until the flood waters have entirely receded, and then pump slowly.

Cleaning and Repairing Your Basement

Shovel mud from the basement as soon as all water has drained or has been pumped out to allow basement floors and walls to dry.

To remove silt or dirt stains from the face of concrete or masonry foundation walls, rinse thoroughly with a high pressure hose and clear water. If the stains still remain, soak the wall with clear water, then scrub the wall using a household detergent solution and stiff bristle brushes. The wall should be wet to prevent the detergent from absorbing into the pores of the wall. Begin at the top and work down. Rinse often.

If, after cleaning, ventilation does not remove remaining odors from the basement, mop concrete floor and walls with a solution of $\frac{3}{4}$ cup of 5 1/4% sodium hypochloride household laundry bleach to each gallon of water. Rinse and dry after five minutes. Open basement windows for maximum ventilation when applying the bleach solution.

To absorb most odorous substances from the air in small enclosed places in the basement, use dry lump charcoal in open tin or metal containers. **CAUTION:** Charcoal is highly combustible when moist or wet; therefore, guard against spontaneous combustion and fire. Keep it away from flammable liquids and gases, cloth, coal, and firewood or other readily combustible materials. Store in a well ventilated, dry place. Or use a commercial chlorophyl wick deodorizer or a "one drop" deodorizer.

Concrete floors can be patched with a portland cement concrete or an epoxy patching compound. Be sure area to be patched is clear of all debris.

Concrete can be used for patches 1-inch deep or more. Area to be patched must first be thoroughly roughened with a chisel and cleaned. Then the surface is wire-brushed and all dust and loose particles are

washed away with clean water. Cracks to be patched should be slightly undercut.

Dampen the surface to be patched. The old concrete should be only damp—no excessive water should be present on the surface. Make a thick, creamy mixture of portland cement and water and brush it on the prepared surface. The patch should be placed before this creamy mixture dries.

Make a stiff mix patch of one part portland cement, two parts sand, and two parts pea gravel. Tamp this mixture firmly into the cavity and smooth off lightly with a wood float. After the concrete patch begins to stiffen, finish with a steel trowel or wood float. For narrow cracks where pea gravel can not be used, use a mortar patch made of one part portland cement and three parts sand.

Keep the freshly placed patch damp for a minimum of five days. Follow manufacturers directions when using an epoxy patching compound.

If a heaved basement floor does not return to its original level, it may be necessary to remove and replace it. First, remove any soft or mucky places to provide uniform subgrade support for the replacement slab. Place 4 inches of crushed stone or gravel fill on the subgrade. Cover this with a 4 or 6 mil polyethylene vapor barrier to stop the movement of water vapor. Then place a 4-inch concrete floor over the vapor barrier, and seal the joints between the floor and walls with hot bituminous or other appropriate joint sealer. **WARNING:** Once concrete material sets up you can't work with it anymore. Be sure you have enough help to do the job before concrete is delivered.

If the basement floor returns to its original level but a bad surface or objectionable cracks remain, a new floor may be placed over the old one if there is sufficient head room. A vapor barrier should be placed between the floors. The new floor should be at least 2 inches thick. A thin epoxy topping can be "welded" to the old floor slab, but the material is expensive.

Drying Out the Structure

Start drying the structure as quickly as you can to lessen or stop further damage and deterioration from corrosion, wood decay, and mold. Even if immediate action is taken, drying may take several weeks if the weather is damp.

Try to maintain the inside temperature at 70 degrees F or at least 15 degrees F above the outside temperature to increase the drying rate. Maintaining a higher interior temperature may not be practical during summer months.

Open doors and windows to allow moist air to flow out of the house during the drying process. Open closet and cupboard doors and drawers.

If outside temperature drops to the point where inside temperature cannot be kept high enough for reasonable comfort, close doors and windows almost

completely. Keep enough ventilation to prevent steaming in the house. If your attic has been inundated with flood or rain water, be sure that roof, attic, eave, and other vents are clear and open.

Electric fans may be used to improve air circulation for drying. Drying can be hastened in an enclosed or basement area by operating a portable electric dehumidifier.

If flooding was not severe and if exterior siding is a permeable material such as wood or asbestos cement, wall cavities will dry simply as a result of the higher interior temperature. The water being driven outward may blister paint and require repainting the outside of the house.

If your wood framed walls are waterlogged, weep holes can be drilled to the exterior or the interior. It is frequently less damaging to remove the baseboard and punch large drainage holes from inside the house through drywall or plaster. This, of course, soaks the floor, but if walls are water filled, the floor has already been soaked. **CAUTION:** Look out for pipes and wires that may be behind the area being punched through. After draining and drying are completed, patch the drain holes and replace the baseboard. See Figure 5-4.

Note: If exterior walls have been filled with water, remove sections of drywall to determine whether batt or pour-type insulation inside the wall has been damaged. These inspection ports can be repaired after drying is complete. Some batt or poured insulations compact and become virtually useless; others dry out to nearly their original form and effectiveness. Board type and foamed-in-place insulations should not be adversely affected by temporary soaking.

Wood paneling may be temporarily removed or loosened to permit wall cavities to dry out. This helps to protect paneling from splitting, delaminating, and fungus growth. See Figure 5-6.

Make certain that weep holes are open across the lower exterior of brick walls. Moss and mildew can be removed from brick, stucco, or stone by scrubbing with a stiff bristle brush and water. Then wet the surface for 10 minutes with a solution of $\frac{3}{4}$ cup 5.25 percent sodium hypochlorite household laundry bleach per gallon water, and rinse thoroughly. Repeat if necessary. See Figure 5-7.

Oozing water and wet spots on hollow-core masonry block walls are evidence of water inside. You can drill a $\frac{3}{8}$ -inch weep hole half way through the wall from the exterior face below the water filled section and just above floor level. If a large area appears to be water filled, drill weep holes above floor level at the lowest points. Water will be likely to migrate within the cores of the block wall to the drain. It will not migrate past a doorway. If any salts appear on the surface of masonry or concrete, brush them off. If more appear, it is a sign that the structure is still drying.

Before redecorating, the walls - inside and out - should be thoroughly dry. This may take months. If rust

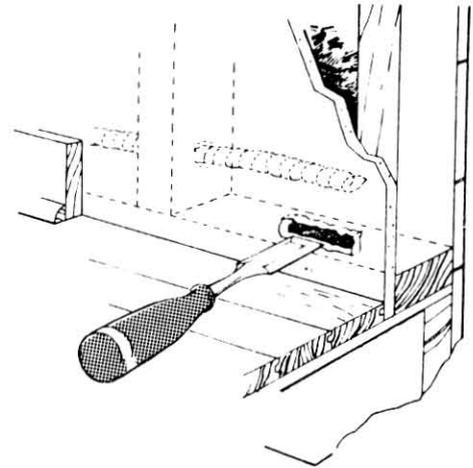


Figure 5-5
Penetrating Drywall

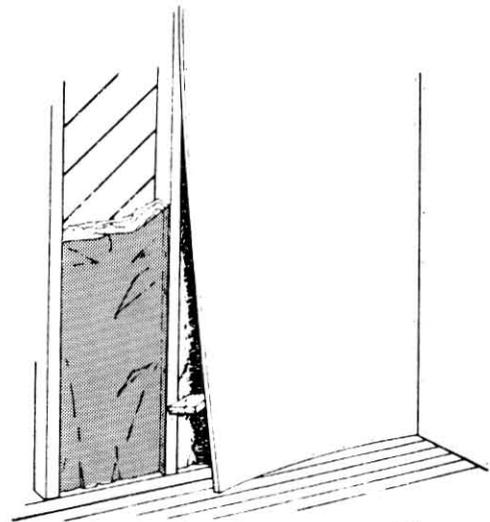


Figure 5-6
Opening Wood Paneling

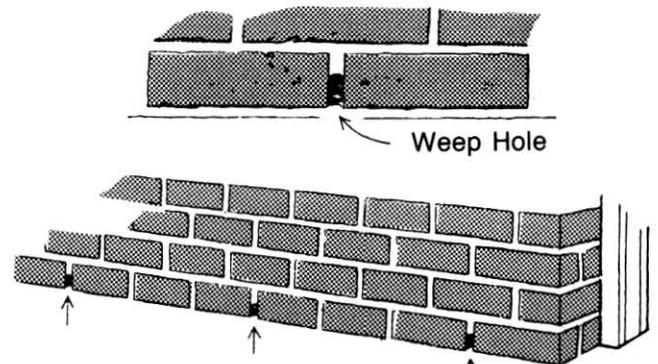


Figure 5-7
Weep Holes in Brick Walls

spots from metal lath have bled through plaster, wash them from the surface and apply a primer compatible with both the base and the new coating; for example, plaster primer-sealer for use under latex paint.

Masonry Repair

Inspect masonry walls and chimneys for misalignments, cracks or deteriorated mortar joints. If misalignments or cracks are found, check underlying foundation support for damage. If mortar joints are in poor condition, have a mason tuck point (also called repoint or point) the mortar.

To Tuck-Point Masonry Mortar Joints

Make a Type N mortar mix by combining:

- 1 part by volume of portland cement
- 1 part by volume of hydrated lime
- 6 parts by volume of sand, measured in a damp, loose condition

Mix the cement and lime and then mix very thoroughly with the sand with just enough water to form a ball in your hand. Let the mixture set for 1 to 1½ hours to prehydrate. Remix with enough water to make a workable mortar which will retain a good body. Evaporation during work may require the addition of enough water to restore the mortar to its original consistency. Mortar should not be used later than 2-1/2 hours after the original mixing.

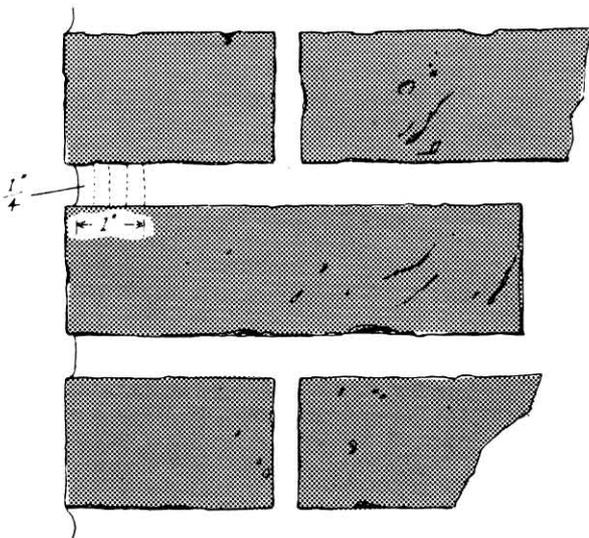


Figure 5-8
Tuck-Pointing Masonry Joints

Deteriorated mortar joints should have the old mortar cut out to a depth of one inch to insure an adequate bond between new mortar and existing masonry. In addition, any loose or disintegrated mortar beyond the 1-inch depth should be removed. Use a cold chisel

blade narrow enough to fit into the joint. Care must be taken to avoid damaging the bricks or blocks. The back of the cut should have square corners.

Masonry and old mortar should be dampened slightly by spraying with water droplets just before beginning to fill the joint. Then apply about one-fourth-inch of mortar to the back and corners of the joint.

When the mortar has hardened to "thumb print" hardness, apply another similar layer and pack well as shown in Figure 5-8. About two more layers will be required to fill the joint flush with the outer surface of the wall. Be sure that each layer has become stiff before each succeeding layer is applied. When the final layer of mortar is thumb print hard, tool the mortar to match the appearance of the old mortar.

Cleaning

Remove and burn or bury driftwood, rubbish, and decaying vegetation.

Wash out mud, dirt, and debris from your home as soon as you can. Use a hose and start from the top or upper limit of the flooding and work downward to the floor or basement.

Wash surfaces that have been inundated with flood waters in order to reduce the danger of flood-carried infections. Pay particular attention to surfaces that children can reach. Cleaners are suggested for specific surfaces in subsequent sections of this manual.

Windows

Be sure that broken glass is removed from the frames of all windows.

If the windows are swollen and cannot be raised, use a wood chisel to take off the small strip (inner stop) that holds the lower sash. Be careful not to mar the woodwork. Force the lower window up slightly to clear the stool (sometimes called the sill), and remove it from the frame by pushing it from the outside into the hands of a helper. Do not push against the glass.

Once the window has dried, you can determine the extent of damage, what can be salvaged, and what must be replaced. If the swelling against the jamb or stops was extensive, the outer wood cells might have been crushed, resulting a loose fitting window when the window dries.

Doors

Do not force open a door; it may be swollen tight, the flooring may be buckled, or debris may be piled against it. Instead, enter by a window or other opening, and remove the pins of the door hinges by lifting them out with a screwdriver and a hammer. Be careful not to break cast-iron hinges. Be sure the door is unlocked and then carefully push it in from the outside to avoid further damage.

Do not attempt to plane or fit a door until the door, frame, and jamb have thoroughly dried.

Wash doors with a mild alkali solution such as 5 to 6 tablespoons of washing soda - a non-sudsing product is better - to a gallon of water.

Walls and Ceilings

If walls are out of plumb or ceilings are not level, investigate the underlying foundations for movement or undermining. Make certain that you are not attempting to correct a misalignment that was built into the original structure.

Hose down flooded plaster* or drywall** walls and ceilings to dislodge mud and grit. Drywall should not be touched further until it is completely dry. If necessary, plaster walls and ceilings may be wiped gently with a slightly damp cloth. Stains can be painted over or covered with wallpaper once the wall is completely dry. The reason for this gentle treatment is that plaster and drywall lose a substantial amount of strength when wet and are vulnerable to physical damage. They may regain strength and hardness when dry. Even hosing them down can cause damage, but the mud and grit must be washed out so that drying can be completed as soon as possible to prevent wood decay.

FOOTNOTES: _____

* Plaster walls are constructed by troweling or spraying several coats of plaster over metal, rock, wood, or gypsum lath.

** In drywall construction, large semirigid sheets of gypsumboard (plasterboard) are attached to the structural members. Gypsumboard has a hardened plaster core or center layer covered with strong paper, fiberboard or felt.

Parts of damaged drywall partitions can be cut out and replaced with new material. The undamaged drywall is left intact. Vertical edge cuts must be made at the centers of wood studs so each end of the repair sheet is nailed directly to a stud. Taping and spackling will cover the cut line. See Figure 5-9.

Scrub wood paneling and other woodwork including painted surfaces with a stiff bristle brush, plenty of water, and a detergent to remove mud and silt from corners, cracks, and crevices. To remove mildew, scrub with a mild alkali solution, such as 4 to 6 tablespoons of washing soda or trisodium phosphate to 1 gallon of water. (Paint stores and grocery stores sell these products under various trade names.) If mold has grown into the wood under paint or varnish, use 4 to 6 tablespoons of trisodium phosphate and $\frac{3}{4}$ cup of 5.25 percent sodium hypochlorite household bleach to 1 gallon of water. Rinse well with clear water. Allow wood to dry thoroughly.

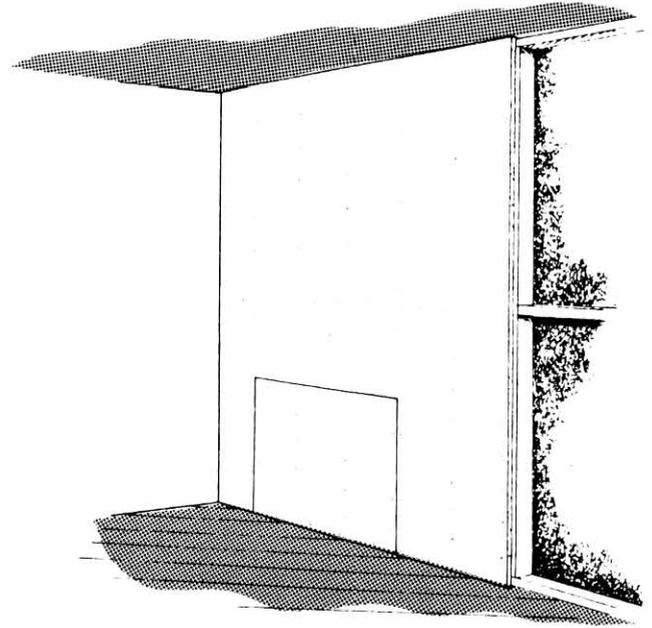


Figure 5-9
Drywall Repair

Remove nail or other stains from woodwork by bleaching with one part oxalic acid and five parts water. If this is unsuccessful, try staining the woodwork a darker color. **WARNING:** Oxalic acid is poisonous. It must be handled carefully, be kept away from children, and be rinsed off treated surfaces.

Badly soaked wallpaper is not salvageable, generally, and should be removed. If it is salvageable (not badly discolored or brittle), repaste any loosened edges with commercial wallpaper paste.

Clean unwashable wallpaper with commercial putty-like wallpaper cleaner. Use a mild soap or detergent and two sponges and two buckets to clean washable wallpaper. One sponge is for the cleaning solution, and the other is for clean rinse water. Test wash a small, inconspicuous spot first. If the results are favorable (paper does not fade or tear), wash the paper beginning at the bottom and work up so water will not run down and streak a soiled area. Water running down over a clean area can be wiped off without damage.

Wash an area that you can reach easily without changing position; rinse immediately; then wash the next area, overlapping the first; and proceed until the wall is finished. Squeeze as much water as possible out of the cleaning and rinsing sponges and work quickly so the paper does not become soaked.

Remove grease spots from wallpaper by applying a paste of drycleaning fluid with cornstarch or talcum. Allow to dry and brush off; repeat as necessary. **CAU-**

TION: Fumes from all drycleaning solvents are toxic and some are flammable. Use only with adequate ventilation and read and heed precautions on the label.

To renovate exterior plastic siding, clean with a nonabrasive household detergent and thoroughly rinse. If mildew is present, clean with a commercial mildew wash or mildew siding cleaner.

Floors

Do not attempt to straighten warped or buckled wood floors until they have dried out. Wood and plywood expand when wet, then return to near original dimensions when dry. Flooring may require replacing, refastening, or refinishing, but if there is any question, wait until after drying is complete to make the decision. Remove floor coverings, if practical, to allow the flooring to dry. Mop off excess water as soon as possible.

After completely drying, re-nail the floor if necessary. Some surface roughness may be removed by planing or sanding. Wood flooring planed heavily may never look well enough to be used uncovered, but smoothed old floor can serve as a base for either a new wood floor or floor covering such as resilient tile or vinyl sheet. If damage is too severe, the flooring may have to be removed and relaid. If only the surface finish of wood flooring is damaged, it may be refinished.

Remove ceramic or terrazzo tile if installed on water vulnerable underlayment or subflooring such as wood. Clean and reinstall, using a moisture-proof sealant or adhesive after the underlying material has dried thoroughly or has been replaced.

If long submersion has loosened adhesives and warped wooden underlayment or subflooring, tiles (asphalt, plastic) may loosen. Remove loose pieces of tile until the underlayment has completely dried. The floor covering may then be re-cemented in place. If sheet linoleum has bulged, water may have seeped under a large section. If so, carefully remove the entire sheet; otherwise, water may be contained underneath, causing the wood to rot. If you do not remove the sheet, small blisters may be left in the linoleum after the wood underfloor has dried. If this happens, carefully puncture the blister with a small nail and re-cement by forcing linoleum paste through the nail hole and weighing the linoleum down with boards or bricks. If linoleum is broken, brittle, and cannot be salvaged, remove it with a chisel or hoe. Be sure to let the underfloor dry thoroughly before laying any type of floor covering.

Electrical Distribution Systems

Every portion of your electrical system that has been covered with water or mud should be checked and reconditioned by an electrician before it is used. If the watt-hour meter and circuit breaker (or fuse) distribution panel have remained dry, flooded circuits may be disconnected at the panel to permit unflooded circuits

to be used. Check any circuit of which any component has been under water.

The electrician, not the home owner/occupant, should recondition circuits as follows:

- * Turn off main power switch and disconnect main busses to assure that power lines are not energized again without your knowledge. Under emergency conditions, most electric utilities allow licensed electricians to remove the watt-hour meter to disconnect power.

- * If the circuit breaker (or fuse) panel was flooded, mark all circuit breakers (or fuses) to indicate their exact position on the panel; then remove them. If panel wiring is covered, remove the cover panel and hose the panel wiring clean. Allow box and fittings to dry. After circuits are checked, replace each plug, fuse, cartridge fuse, or circuit breaker with a new one of the same amperage in each location. Sealed glass plug fuses may be dried and reused if there is no evidence of water having entered the fusible link section. Make certain each flooded circuit has been reconditioned before its fuse or circuit breaker is replaced.

Follow the procedures given below when electrical wall outlets and switches have been submerged.

- * Remove cover plates from all outlets that have been under water. Thoroughly rinse the inside of the receptacles and boxes with fresh water, preferably with a high-pressure hose.

- * Direct water from the base into the holes in which the appliance plugs are normally inserted. After rinsing the receptacle, a plug should be inserted into each receptacle to help remove the remaining mud and silt. Then rerinse.

- * Replace the receptacle plates only after the receptacle and its box are thoroughly dry.

- * Switches that have been under water may be damaged beyond repair. To determine this, remove the cover plate and thoroughly rinse the switch and its box with clean water. Operate the switch. If it seems to work satisfactorily, move it up and down at least 10 times and then rinse it again. If the switch still operates, leave the plate off until the switch and its box are thoroughly dry. Operate the switch again. Do not be surprised if it will not work — during the drying process the mechanical insulation may have warped, rendering the switch inoperative. However, if the switch still seems to operate satisfactorily, the switch likely will work when the power is turned on. If the switch fails to operate at any stage, replace it with a new one of the same rating.

- * Rinse permanently mounted light fixtures and lamps with clean water and let dry. As was the case with wall switches, lamp switches may need replacement.

Note: Various products on the market known as water displacement solutions will assist in the process of drying electrical equipment. They clean, penetrate,

protect, displace moisture, and prevent corrosion and rust on electrical and electronic equipment and are available in bulk or spray cans.

Allow the entire wiring distribution system of the house to dry; in most instances, wiring will dry satisfactorily and serve its normal function. Check out the entire wiring system for shorts or grounds, particularly if the wiring is more than 10 years old. Older electrical equipment and wiring are more likely to require replacement following submersion in flood water.

With the panelboard and wiring distribution system dry and reconditioned, reapply electrical power. First, be sure all ON/OFF switches are set at the OFF position and circuit breakers are replaced and installed in the OFF position. Turn main circuit breakers to ON position. Close one circuit breaker or insert one fuse at a time so the branch circuit controlled by the circuit breaker or fuse can be checked. If the fuse blows or the circuit breaker opens, a fault still exists in that circuit. Re-check and re-clean outlets and switches with circuit breaker OFF or fuse removed. If the fuse or circuit breaker does not blow, check exposed wires and each outlet and switch in that branch circuit for smoke or other sign of faults. If so, remove the fuse or open the circuit breaker and repeat this step. If no difficulty occurs, repeat the procedure with each of the other branch circuits. After branch circuits have been checked individually, and all difficulties corrected, plug in and operate an appliance known to be in good condition at each outlet.

WARNING: It is essential that all repair and replacement work be done with UL approved materials and in a manner that meets all local and national electrical codes and standards.

Heating System

If you have a gas- or oil-fired forced air furnace, flooded components of the heating system, i.e., the air intake, combustion chamber, heat exchanger, blower smoke or vent pipes, chimney, air ducts, and pumps, should be inspected by a heating serviceman and cleaned of any debris, mud, or silt deposited by the flood. Such material lodged in pipes, ducts, or air or fuel passages could make operation inefficient or dangerous. As a result, the house could be filled with smoke, excessive carbon dioxide, or highly poisonous carbon monoxide gas.

Do-it-yourself reconditioning is not recommended for heating systems that have been subjected to major flooding and mud encrustation for the following reasons:

- * Fuel and air mixtures may require readjustment.
- * Unskilled cleaning efforts may cause leaks or structural damage to vent piping, vent connections, and chimneys, especially on older heating systems.
- * Fuel leakage can bring about dangerous fuel concentrations leading to overheating, runaway combus-

tion, or possible explosion.

* Disassembly and proper reassembly of burners, motors, blowers, boilers, and control devices require expertise often beyond the average householder's experience.

Fuel tanks and supply lines should be checked carefully also for water infiltration, leaks, or damage. Tank foundations may have experienced undermining or shifting.

Plumbing System

To check out the house water supply system, be sure all valves and faucets are closed. Then open only those required to test each valve, faucet, or plumbing fixture. This procedure will prevent siphonage that could contaminate the water system.

If a manually operated cutoff valve on the sewer line was closed prior to the flood to prevent backflow, open it slowly. Run enough water through the drains to assure that sewer lines are open. If a line is obstructed, a plumber will probably have to clean out the valve and sewer line.

Septic tanks are not apt to be damaged by flooding. However, the soil absorption part of the system (drain field or cesspool) may be reduced in effectiveness by a mat of sludge or greasy scum washed out of the septic tank into the absorption field. In addition, surface water may flood the absorption system and force its effluent to the ground surface. Surface appearance of effluent near the low end of the drain field indicates a failure of the absorption system to handle the load.

When the top of the septic tank has been inundated the residence must cease to discharge sewage into the tank. As flood waters recede, the system may again be used when the soil water level is below the bottom of the drain field trench. Soil water level may be tested by digging a hole beside the drain field trench and observing the water level in that hole.

It has been recommended that septic tanks be opened after the flood has receded and before the system is again used. Any scum trapped in the inlet and outlet tees (or baffles) should be removed. The septic tank should also be emptied of all solids and liquids by a septic tank pumping service. This will reduce the possibility of excess scum entering the absorption system. It will also allow several additional days for the absorption system to dry out while the septic tank is refilling with sewage.

Open a faucet, flush the commode, or pour in a bucket of water to test the drainage of basement plumbing fixtures and floor drains. Water will run away if the drains are unobstructed.

If sink or bathtub drains are stopped, try clearing the obstruction with a "plumber's helper," suction cup, sewer rod, or drain auger. If this does not clear the drains, look for a cleanout plug on the bottom of the U-, P-, or S-shaped trap found under most such fixtures.

If there is no removable plug, remove the trap by loosening its coupling nuts and clean out the mud or debris with a wire, wash clean, reassemble and test again. If blockage still occurs, the obstruction is farther down and you will need a plumber's snake or drain auger. Obstruction of toilet and floor drains can be cleared by rodding with a drain auger or possibly with a wire (coat hanger) or a long narrow swab. If the obstruction cannot be cleared, look for a pipe cleanout in the drain line. Remove the cleanout plug and use a sewer rod or drain auger to clear the drain line. See Figures 5-10 and 5-11.

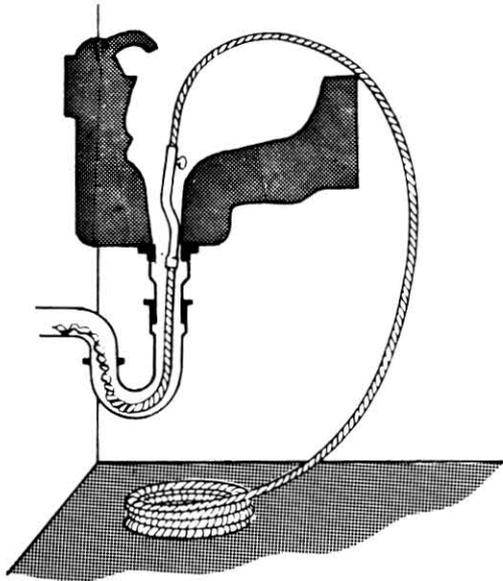


Figure 5-10
Drain Auger

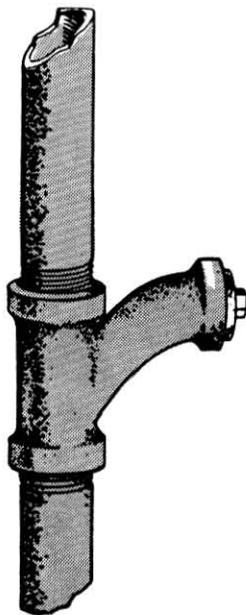


Figure 5-11
Wye With Cleanout Plug

As the last resort to freeing the toilet drain, the bolts holding the fixture to the floor can be removed and the toilet set aside to expose the 4-inch diameter drain pipe. This practice will generally require that the gasket ring under the toilet be replaced.

Hot Water Heater

A flooded hot water heater should be repaired by an experienced repair person only. Controls can suffer hidden corrosion damage. They may operate adequately for a while, but cease to operate safely in the future. Testing seldom reveals future problems. Burners or electrical components should not be assembled or adjusted by the home owner/occupant because:

- * Safety controls cannot be evaluated adequately by visual inspection. Flooded control components should be replaced with new ones.
- * Possibilities of shorts or grounds in 115-volt or 230-volt electrical equipment and explosive fuel concentrations or improper combustion in gas burners carry potential danger of personal injury and fire. These safety hazards coupled with the intricacies of assembly and adjustment make home repairing a dangerous undertaking.
- * Soaked tank insulation may be matted and rendered ineffective.

It is frequently more feasible to replace a flooded heater than to repair it.

If the water supply has been contaminated, chlorinate the water heater tank after a pure water supply has been restored.

To decontaminate the water heater turn off the gas valve or the electrical switch serving the water heater. Close the cold water inlet valve at the heater. Open the nearby hot water faucet to allow air to enter the piping and heater. Drain about 2 gallons of water out of the drain valve on the bottom of the water heater. Close the drain valve. Remove the relief valve from the hot water outlet pipe above the heater or disconnect the hot water outlet pipe from the heater to provide a top orifice for adding the chlorine solution. Mix the required amount of liquid chlorine laundry bleach from the table below with enough water to make about one gallon of solution. (Make certain that the label specifies 5.25 percent sodium hypochlorite solution with no additional active ingredients.) The water heater identification plate, usually on the back side of the heater near the floor, will list the capacity.

For Disinfection Strength about 100 parts per million

Gallons water heater capacity								
10	20	30	40	50	60	80	100	

Fluid ounces of 5.25 percent liquid chlorine bleach (use a measuring cup)

2.5	5.0	7.5	10.0	12.5	14.5	19.5	24.5
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Using a funnel, pour the chlorine solution into the heater through the hot water outlet pipe or relief valve.

Open the cold water inlet valve at heater and completely fill the tank with water. Close the inlet valve. The tank water level can be checked by observing the hot water outlet pipe. Allow the solution to stand in the heater for one hour. Completely drain the solution from the tank through the heater drain valve. A hose can be attached to this drain and run into a nearby floor drain.

Close the heater drain valve, open the cold water inlet valve, and fill the tank with water. Allow the water to stand in the heater for 10 minutes. Replace the relief valve in the hot water outlet pipe or reconnect the hot water outlet pipe. (Do not yet close the hot water faucet opened earlier.)

Completely drain the water from the tank through the drain valve located at the bottom. Open the cold water inlet valve and fill the tank with water again. Close the hot water faucet.

Check for water leaks at all fittings used during the chlorination process. Repair them if necessary. Turn on the gas or electrical switch. Relight the gas unit according to instructions on the heater. Check for normal operation. Any residual chlorine taste or odor will gradually dissipate as the water heater is used.

Wells and Water Systems

First, the volume of water in the well must be determined. The table below gives the number of gallons for each foot of water standing in the well.

Diameter of well									
4"	5"	6"	8"	10"	12"	16"	24"	36"	48"
0.7	1.0	1.5	2.6	4.1	5.9	10.4	23.5	52.9	94.0

Multiply the bottom figure (gallons of water) times the number of feet of water standing in your well to obtain the total gallons of water in the well. For example, an 8-inch diameter well with 20 feet of water will contain about 52 gallons of water (2.6 times 20).

Multiply the number of gallons of water in the well times 0.25 to obtain the number of fluid ounces of 5.25% liquid chlorine laundry bleach* to be used or refer to the following table:

For Disinfection Strength about 100 Parts Per Million

Gallons of water in the well				
10	20	40	80	100
2.5	5.0	10.0	20.0	25.0

For each additional 100 gallons, add 25 ounces of bleach. Add the bleach to at least 5 gallons of water.

Footnote

* Make certain that the label specifies 5.25 percent sodium hypochlorite solution with no additional active ingredients.

Pour the bleach/water solution into the well making certain to wet interior surfaces of the well casing and the drop pipe. If possible, agitate the water in the well to insure mixing.

Let solution stand for 12 hours in all wells except dug wells. Dug wells should stand 24 hours prior to flushing.

Pump treated water from the well. If possible, recirculate pumped water back into the well for 30 minutes.

Pump treated water into the house's pressure system. Open outlets or faucets until each outlet gives a strong odor of chlorine, then close outlets. Make certain that the water heater tank has been filled with treated water by checking hot water outlets as well as cold.

Let stand in the pressure system for one hour.

Flush the system by running water from each outlet until both chlorine taste and odor have disappeared. Drain the hot water heater to remove any accumulated silt or heavy impurities.

Household Appliances

Do not attempt to operate or apply power to any appliance that was in flood water until it has been cleaned and dried thoroughly and, preferably, examined by a repairman to be sure it is safe to use. Competent repair service of flood-damaged appliances will include cleaning, drying, recoating, and backing of electrical windings; cleaning and servicing contacts and moving parts; disassembling, cleaning, and lubricating gear boxes and bearings.

Silicone solvents and other water displacement chemicals can be used to restore and protect electrical appliances and devices. Read and heed directions on the aerosol cans or liquid containers if you plan to service the appliance at home.

Small or Portable Appliances

Clean small or portable non-immersible appliances such as toasters and mixers. Appliances contaminated by flood water may be partially disassembled, wiped clean, or even washed with clean water. They must be dried thoroughly. You can hasten drying by placing them in an oven that has been warmed and turned off.

CAUTION: Plastic, insulation, and other appliance materials can be damaged if exposed to too much heat. Now, test them. If they fail to operate, send them to a repair shop for reconditioning. It may be impractical economically to recondition older appliances in some cases.

Washers and Dryers

As soon as possible, hose and wash washers and dryers with clear, clean water. Open the entire cabinet and control panel to allow thorough access to the interior and thoroughly clean interior sections of all mud, silt, and other debris. Open the gear housings and clean shafts and gears with kerosene. Wipe all parts with a clean cloth, but do not force any dirt into the bearings. Unseen grit can cause wear of moving parts. Wipe metal surfaces with a rag moistened with kerosene to remove rust and dirt stains and coat them thinly with petroleum or machine oil to prevent further rusting. Oil the bearings and, using a soft cloth, dry surfaces exposed to hands or clothing. Afterwards, allow all parts to thoroughly dry, particularly all wiring and electrical components. If motors have been removed before flooding, reinstall them; however, if they were not removed, take them to a competent repair shop for reconditioning. Before using these appliances, have them checked by a qualified service person. At the time of start up, exercise care that they are grounded and properly fused in the event any short circuiting might occur. **CAUTION:** Burn kerosene-soaked rags out of doors; if they are washed in an automatic washer, an explosion may result.

Refrigerators and Freezers

Most modern refrigerators have permanently sealed cooling systems and should not be affected by flood, but in old refrigerators, the cooling unit is accessible and should be examined and cleaned. Have refrigerator wiring, switches, and controls cleaned, dried, and checked. A competent service person also should check insulation for absorption of moisture.

Thoroughly clean the interior and exterior of refrigerators and freezers. To disinfect refrigerators and freezers, wash inside surfaces with a solution of 3/4 cup of 5.25 percent sodium hypochlorite household bleach to each gallon of warm water. Rinse and dry, then air for a few minutes. If odors persist, use about 3 ounces activated charcoal (available at drug stores) in an open container. Food can remain in the refrigerator or freezer with the charcoal. After 3 to 6 hours, put the pan of charcoal in a moderate oven to drive off the odor and "reactivate" it. Repeat this procedure until they have been completely deodorized. Save the charcoal — you can use it over and over again. If only traces of the odor remain, this is not likely to affect the food frozen stored in the freezer if care is taken to wrap the food securely.

Ranges

Disassemble, as far as possible, gas surface units and drain and clean all components.

Disassemble, clean, and dry electrical control panels and have them checked for safety by an electrical repair person.

Completely disassemble, clean, and thoroughly dry electrical cook tops. The electrical elements, particularly, must be checked by a qualified individual or repair person to be sure that moisture is baked out and that no electrical leakage can occur.

Ovens, both gas and electric, usually are insulated with mineral fiber material that absorbs moisture. Ovens must be disassembled completely and the insulation usually must be replaced. For oven gas burners and electric units, follow the same procedure as for cook tops. Deodorize by washing with 1 teaspoon baking soda to 1 quart warm water or by using activated charcoal in an open container.

Dishwashers

Sufficiently disassemble dishwasher to assure that all components can be cleaned and dried. Remove motors, unless they are the totally enclosed types (most are not), and send to a motor repair shop for reconditioning. Replace any insulation around the tub that has become saturated if it cannot be dried adequately. Have all wiring and switches thoroughly cleaned, dried, and carefully checked for electrical safety. Complex and unsealed control switches probably will require replacement.

Reconditioning Electric Motors

Small electric motors must be dried, cleaned, and lubricated by a person accustomed to working with them. Otherwise, there is the risk of electrical shock by short circuits and improper ground.

Small electric motors may be dried in an oven at not more than 150 degrees F. Test them after 6 or 8 hours of drying. If there is still evidence of grounding or short-circuiting, return the motor to the oven for another 2 to 4 hours before testing again.

To inspect and recondition a motor, proceed as follows:

Remove and thoroughly wash all bearings that are not sealed; then replace them after oiling or greasing. Clean the oil wells supplying the bearings and fill them with fresh motor oil.

Clean centrifugal switches, slip rings, and commutators of grit and dirt particles and examine brushes to see whether they move freely in their holders.

Take out the armature, or rotating member, and clean it well with water from a hose under low pressure or with pails of water. High pressure water or air may cause even fine grit to damage surfaces or insulation. Treat the stationary coils similarly. After washing with water, wash with kerosene, not gasoline. **CAUTION:** There should be no smoking and no exposed flame near the place where kerosene is being handled.

Dry the motor coils, either rotor or stator, by heating to a temperature of about 150 degrees F for 10 or 15 hours. Then paint the windings with a light insulating varnish. Apply the first coat and bake for a period of

4 or 5 hours at a temperature of 200 degrees F to 250 degrees F, then apply a second coat and bake for 3 or 4 hours at the same temperature to ensure a good job.

Before assembling the motor or generator, check starting contacts for corrosion and lubricate lightly all moving parts. Replace oil wicks and renew oil in reservoirs. If sealed-type ball bearings have leaked — allowing grit to enter — soak them in gasoline or oil and blow out any loose grit by compressed air. With the sleeve-type bearing, remove dirt with kerosene and replace old wicks with new material. If the capacitor overheats, remove it and bake it in mild heat for several hours. If it continues to overheat, get a new one.

Reconditioning Household Items

Mechanical surfaces of these mechanisms are extremely vulnerable to rust. A delay of even two or three days may rust them beyond economical repair. For this reason, speed in getting the mechanisms dried and lubricated is important.

The most satisfactory method of stopping rust on machined mechanical assemblies is on a community basis, with one simple processing line providing derusting treatment for all. This could be conveniently established at a garage, service station, or other location which has an air pressure tank. An emergency rust inhibiting treatment is as follows (See Figure 5-12.)

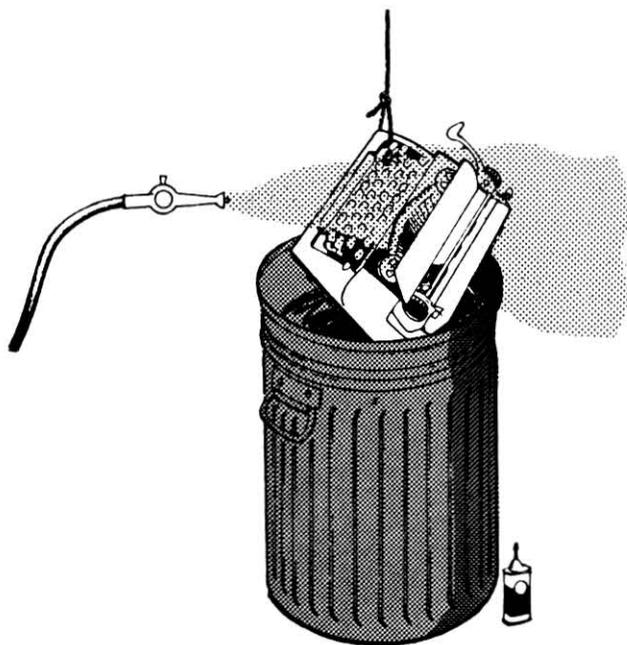


Figure 5-12
Air Blowing A Typewriter After Dipping

1. Remove cover plates and disassemble as far as practical.

2. Dip the mechanism into a container of perchlorethylene. (The local cleaner uses it to dry-clean clothing.) Slosh it around to force water out of close fitting surfaces. **WARNING:** Do not soak for a long period. Long term soaking may unduly damage rubber or plastic parts.

3. Blow dry with an air hose to remove the perchlorethylene. Air pressure below 60 psi is preferred, to avoid blowing small springs and friction-fit parts loose.

4. Replace protective oil film that was removed by the perchlorethylene. A light No. 6 clear oil should be used, preferably applied from a spray can. Hardware and auto supply stores carry this type of oil under various brand names. Spray the oil onto all rust vulnerable surfaces. Give particular attention to close fitting surfaces where direct spray will not reach.

5. Blow off excess oil with the air hose. During the blowing, try to blow oil into hard-to-reach surfaces.

6. Store in a dry place until the mechanism can be carefully disassembled and repaired.

Perchlorethylene is preferred to hydrocarbons such as kerosene because it is non-toxic, nonflammable, and less damaging to plastic parts.

Television and Radio Sets

Television and radio sets usually function satisfactorily after floodings if they have been cleaned and dried. It is unnecessary, usually, to discard such equipment. A competent repair person can tell you if it is repairable.

Household Metals

Wash and disinfect all cooking utensils before they are used again. Remove all wood or plastic handles from frying pans and saucepans and clean every piece of any equipment that can be taken apart. Wash cooking utensils in hot soapsuds, using a brush if necessary to remove dirt. Rinse in clear water. Disinfect as described below.

Remove rust from cooking utensils by scouring with steel wool. After scouring and sterilization, rub them with unsalted cooking fat and place them in the oven at 350 degrees F for an hour or so. The fat will seal the pores of the metal making them rust resistant and keeping food from sticking easily to them.

Scour unpolished surfaces of aluminum with soap-filled metal scouring pads and wipe polished or plated surfaces of aluminum with silver polish or fine cleaning powder; then sterilize. To brighten darkened insides of aluminum pans, add water to almost full, add ¼ cup vinegar or 2 tablespoons cream of tartar for each quart of water — or use an acidic food such as rhubarb or apple — and boil for 10 to 15 minutes. If the utensils

have been submerged in flood water and are darkened both inside and out, prepare either the vinegar or cream of tartar solution in a large container and immerse the utensils in it.

Polish stainless steel, nickel-copper alloy, or metals plated with nickel or chromium with a fine-powdered cleanser. If the plating is broken, exposing the base metal to rust, wipe with kerosene, wash and dry the surface, and then wax for rust resistance. **CAUTION:** Burn kerosene-soaked rags out of doors; if they are washed in an automatic washer an explosion may result.

Polish copper and brass with a polish meant for that purpose or with salt sprinkled on a piece of lemon or on a cloth saturated with vinegar.

Take apart locks, especially those made of iron, wipe with kerosene and oil. If you cannot remove them, squirt in a little machine oil through the bolt openings or the keyhole and work the knobs to distribute the oil, otherwise, springs and metal casings will soon rust and need replacing. Do not use so much oil that it will dry onto the woodwork and thus cause staining or make later painting difficult.

Clean and oil door and cabinet hinges.

Sterilizing Dishes and Cooking Utensils

Metal Items and Boil-Safe Utensils

Wash thoroughly. Fill with water or place in water. Bring to a near boil for 5 minutes. Do not recontaminate by rinsing or filling with unsafe water.

Glass, Porcelain, Plastic, Enamelware

Wash thoroughly. Soak 10 minutes in a solution of 1 tablespoon liquid chlorine laundry bleach to each gallon of hot water. (Make certain that the label specifies 5.25 percent sodium hypochlorite solution with no additional active ingredients.) Rinse well with purified water, drain dry (Do not use chlorine solution on silverware, metal dishes, or chipped enamel.)

Furniture

Promptly place pieces of wood or aluminum foil under furniture that has casters or metal caps on the legs to avoid staining carpeting.

When weather permits, take all furniture outdoors, but keep it out of direct sunlight to prevent warping or fading. A garage or carport is a good place to work. Remove as many drawers, slides, or other moving parts as possible. If the furniture is made of wood, these will probably be stuck tight. Do not force drawers with a screwdriver or chisel from the front. Remove the back of the furniture — cutting it out if necessary — and push out the drawers.

If kitchen cabinet doors or drawers are stuck, do not force them open. Once they have dried they should be easier to open.

Clean off all mud and silt from furniture items, using a hose stream if necessary.

To remove mildew from wood furniture, scrub with a mild alkali, such as 4 to 6 tablespoons of baking soda or trisodium phosphate to 1 gallon of water. (Paint stores and grocery stores sell these products under various trade names.) However, if mold has grown into the wood under paint or varnish, use 4 to 6 tablespoons of trisodium phosphate and 1 cup of 5.25 percent sodium hypochlorite household laundry bleach to 1 gallon of water. Rinse well with clear water and allow to dry thoroughly. After cleaning, store the wood furniture inside the house or garage where it will dry slowly; do not leave it out in the sun as it might warp and twist out of shape.

To remove mildew from upholstered furniture, first remove loose mold from outer coverings by brushing with a broom. Do this outdoors if possible to prevent scattering mildew spores in the house. Avoid inhaling the spores. Run an indoor-outdoor wet pick up vacuum cleaner attachment over the surface to draw out more of the mold. Dry the article as quickly as possible with an electric heater, fan, or any convenient method to carry away moist air. Sun and air the article to stop the mold growth. **CAUTION:** Sunlight may fade the color of your upholstery.

If mildew remains on upholstered articles, sponge lightly with thick suds of soap or synthetic detergent and wipe with a clean, damp cloth. Use as little water on the fabric as possible to avoid soaking the padding. Another way to remove mildew is to wipe the article with a cloth wrung out of dilute alcohol (1 cup denatured or rubbing alcohol to 1 cup water) and then dry thoroughly. However, if molds have grown into the inner part of an article, send it to a drycleaning or storage company for drying and fumigation. Fumigation will kill molds present at the time but will not protect the article against future attacks. **CAUTION:** In closed areas, use vapors of paradichlorobenzene or paraformaldehyde as directed to stop mold growth.

Wood furniture that has not been submerged may have developed white spots or a whitish film or cloudiness from dampness. Try rubbing with a cloth wrung out of a mixture of ½ cup household ammonia and ½ cup water, or of turpentine, or camphorated oil or oil of peppermint. Wipe dry at once and polish with wax or furniture polish. If color is not restored, dip 3/0 grade steel wool in oil (boiled linseed, mineral, or lemon) and rub lightly with the grain of the wood. Wipe with a soft cloth. Use a drop or two of ammonia on a damp cloth for deep spots; immediately rub dry with a soft cloth and then polish. Cigarette ashes rubbed in with the finger tips are often effective in removing white spots. If all efforts to remove white blemishes are ineffective, it may be necessary to refinish the furniture.

Badly damaged upholstered furniture that has been submerged may need restuffing. Springs may need to be cleaned and oiled and the frame may need cleaning. If you are not skilled in this work, consult a cabinet-

maker or upholsterer.

Some furniture, especially that made of wood, may be salvaged by regluing component parts. Gluing, however, is fairly difficult to do at home because on many pieces it is necessary to use clamps. Before starting this task, therefore, decide whether it is worthwhile investing in this equipment and whether you have the time and ability to do the work. If you find the work too difficult to attempt, consult a cabinetmaker.

Repairing veneered furniture is so difficult and requires so many different types of tools that trying it at home is impractical. Get a cabinetmaker to do the job, or have the store from which you purchased the furniture send it back to the factory to be repaired.

NOTE:

If insurance allows part value on flood-damaged furniture, it may be worthwhile financially to apply the allowance on new articles rather than to pay for repairs on damaged items.

Rugs and Carpeting

You will have to make a decision regarding cleaning your rugs and wall-to-wall carpeting. If you leave the carpeting on the floor, you risk fostering wood decay, mildew, and warpage of the flooring by hindering its drying and if you remove the carpeting, you risk its shrinkage. Although professional cleaners do have methods for controlling shrinkage, the chance of preventing it entirely for wall-to-wall carpeting is unlikely; however, if you have saved the scraps that remained after the carpet was installed, they possibly may be used to make up the difference in shrinkage.

If you decide to clean your rugs and/or carpeting at home, proceed according to these instructions:

- * Remove as much water as possible with an indoor-outdoor wet pick-up vacuum.

- * Loosen diagonal corners of wall-to-wall carpeting, leaving the remainder intact. Use rust-proof tacks if the carpeting appears to be pulling away. This is not the quickest way to dry carpeting, but it is the only way to do so without shrinkage. Some rugs can be cleaned and dried by spreading them on concrete driveways or sidewalks.

- * Make use of fans to aid in drying carpets and rugs.

- * Once carpets and rugs are dry, vacuum clean, and then shampoo them. The use of a disinfectant also is recommended; however, liquid chlorine should not be used on wool. For convenience, work with small rugs on a table near the sink or laundry tub.

- * Either use a commercial rug shampoo (available at many drug and department stores), following the directions on the package, or make a shampoo solution by dissolving 1 part syndet to 8 parts warm water and beating with an egg beater until very stiff. **CAUTION:** Do not beat up more than ¼ cup of the solution at a time.

- * Apply the foam obtained from either shampoo solution with a soft brush to a small area of the rug, using a light circular motion. Use only the foam. Wipe the area two or three times with an absorbent cloth wrung out of lukewarm water. Change the rinse water from time to time as it becomes dirty. Since moisture weakens the fabric in the back of the rug, use as little water as possible. Use turkish towels or any other soft absorbent material to take up moisture. Apply foam to another small area, overlapping the first. This overlapping ensures that the whole surface will be cleaned well and prevents streaking. Continue shampooing a small area at a time until the entire rug has been cleaned. When rinsing for the last time, brush the nap in one direction.

- * Dry the carpets and rugs as quickly as possible after shampooing by exposing them to circulating warm dry air from a fan or vacuum cleaner attachment. Make sure they are dry completely, for even though the surface seems dry, any moisture remaining at the base of the tufts will damage the rug.

- * After shampooing and drying, pile rugs of the Axminster weave may need resizing to make them lie flat on the floor. To do this, dissolve ½ pound of granulated glue in 1 gallon of boiling water. Lay the clean rug face down on papers in some part of the house where it can remain undisturbed, and tack it down at intervals, being careful to have it straight and true. Then with a white-wash brush or a whisk broom, brush the hot glue over the back of the rug and let it dry. **CAUTION:** Do not use so much glue that it will soak through to the face side of the rug.

- * To get rid of mildew, use a low pressure spray containing a fungicide. Respray frequently, especially in localities where moisture is a major problem.

Clothing and Household Linens

Quickly separate all laundry items to avoid running of colors.

Allow clothing that is to be drycleaned to dry slowly at room temperature, away from direct heat. Shake, brush, or vacuum loose dirt from the articles before sending them to the cleaners.

To clean washable woolen clothes and blankets, first shake and brush to remove dirt, then rinse repeatedly in lukewarm water to remove particles of soil lodged in fibers. Then prepare an abundance of lukewarm suds using a mild detergent. Immerse the wool material and work it gently in the suds or detergent solution with as little agitation as possible. If necessary, wash a second time in lukewarm suds. Rinse carefully in several changes of lukewarm water.

Dry woolens in a warm place but not near a fire or in direct sunlight. Never allow them to freeze. Hang knitted underwear from the shoulders. Spread sweaters and other knitted garments on a table and shape ac-

cording to desired dimensions. Hang blankets over two parallel lines so it forms an M shape; this will distribute weight and allow air to circulate over both surfaces at the same time.

Press wool garments while they are still damp with a medium-hot iron or allow to dry and press on the wrong side with a steam iron. If ironing is done on the right side, protect the surface with a pressing cloth. Be sure to leave a little moisture in the wool or it will look hard and lifeless.

To clean mud-stained, washable clothing and household linens other than woolens, first brush off any loose dirt, then remove as much mud as possible by rinsing repeatedly in cool water. When no more dirt can be rinsed out, wash articles in warm sudsy water — several times if necessary. Hot suds will set stains caused by red and yellow clay. In extreme cases, try bleaching white cottons and linens using a chlorine or perborate-type bleach in further washings. Do not overbleach flood stained fabrics. Sun drying may aid in bleaching. Bleaches may be used on colored fabrics, but follow carefully the directions on the package. Hang blankets over two clotheslines or dry in an automatic dryer with several clean bath towels that are dry and have been preheated. While still damp, brush blankets on both sides to lift nap. Electric blankets should be dried on a clothesline and gently stretched into their original size and shape.

Wash lightweight quilts in the same manner as woolens. Dry outdoors in the sun, if possible, to remove unpleasant odor. Thick comforters may need to be taken apart and the cover and filling each washed separately.

To further ensure sanitization of washable articles, these suggestions can be followed:†

Footnote

†U.S. Department of Agriculture, "Sanitation in Home Laundering," Home and Garden Bulletin No. 97, U.S. Government Printing Office, Washington, D.C., 1971, pages 7 and 8.

* Sanitize the washing machine occasionally to kill bacteria that live on the interior surface. Pour a disinfectant into the empty machine; then complete a 15-minute cycle at the hot water setting.

* Wash the lint trap occasionally with hot water and soap or detergent to kill bacteria collected herein.

* Sort dirty clothes and clean clothes at different times. Do not shake dirty clothes near clean laundry or near surfaces that later will be used for sorting laundry.

* Shaking dirty clothes releases bacteria, which then settle on nearby surfaces.

* If possible, sort dirty clothes on a table or in one area; sort and fold clean clothes on a second surface and in another area. If this is not possible, cover the table or the work area with clean paper, plastic sheeting, or any other clean material before working

with clean clothes. This will prevent bacteria from being redeposited on freshly washed clothes. For the same reason, line clothes baskets with clean paper or plastic before loading them with clean laundry.

* To remove mildew from clothing and household lines, wash fresh stain with soap and water, rinse well, and dry in the sun. If stain remains, use lemon juice and salt, or a solution of 1 tablespoon household bleach (liquid or granular chlorine bleaches or powdered bleaches containing sodium perborate or monopersulfate) to 1 pint lukewarm water. However, do not use chlorine bleaches on wool, silk, or cottons with chlorine-retentive resin finishes. Check dyed fabrics for color-fastness. It may not be possible to remove mildew from some colored fabrics without also changing the color of the dye.

* Remove iron rust and some dye stains with a color remover. It can be bought at drug stores under various trade names. Follow the directions given on the package and rinse well in water.

* Many faded and stained garments and household articles can be made usable by redyeing if the fabrics are still good. Usually, dyeing a fabric a deeper shade of the same color is easier than dyeing it a new color.

* Sanitize your clothing and linen while it is being laundered by adding one of the following disinfectants to either the wash or rinse water:

Quaternary Compounds. Safe for all fibers. Will not damage wool and silk, but there may be some color change. Little or no odor.

- Trade names: Roccal, Zephrein.
- When to add: At beginning of rinse cycle.
- Temperature of water: Hot or warm but cool for wool and silk.
- Amount to use: Top-loading machine - 1/2 cup, front-loading machine - 6 tablespoons.
- What to look for on the label: Benzalkonium Chloride.
- Available in drug stores.

Liquid Chlorine Bleaches. Do not use on wool, silk, or resin-finished cottons. Safe for other fibers.

- Trade names: Clorox, Purex, Hi-Lex Liquid Bleach, Texize Bleach.
- When to add: Before putting clothes into machine; otherwise, dilute in 1 quart water before adding it to the washer. Do not use bleach in rinse water.
- Temperature of water: Hot, warm, or cold.
- Amount to use: Top-loading machine - 1 cup, front-loading machine - 1/2 cup, hand laundry - 2 gallons of sudsy water - 1/8 cup.
- What to look for on the label: Contains 5.25 percent sodium hypochlorite.
- Available in grocery stores.

Pine Oil Disinfectants. Safe for washable clothing. Do not use on wool or silk because odor lingers.

- Trade names: Pine-O-Pine, King Pine, Fyne Pyne, Ocean Spray Pine Oil Disinfectant, Sexton Pine Oil Disinfectant, Texize Pine Oil Disinfectant.
- When to add: At beginning of wash cycle, preferably before placing clothes in the machine. Otherwise, dilute in 1 quart water before adding to the washer.
- Temperature of water: Hot or warm.
- Amount to use: Top-loading machine - 3/4 cup, front-loading machine - 1/2 cup.
- What to look for on the label: Contains at least 70 percent steam-distilled pine oil.
- Available in grocery and drug stores.

Phenolic Disinfectants. Safe for washables but avoid using on wool and silk because odor will remain.

- Trade names: Pine-Sol, Al Pine, Texize 8304 Centrex.
- When to add: Either wash or rinse water.
- Temperature of water: Hot or warm.
- Amount to use: Top-loading machine - 1 cup, front-loading machine - 1/2 cup plus 2 tablespoons.
- What to look for on the label: "Orthobenzylparachlorophenol" or "Orthophenylchlorophenol."
- Available in grocery stores.

In all cases read the label, follow all directions and precautions, measure disinfectant carefully, and add disinfectant to the recommended wash or rinse cycle.

Bedding

Mattresses soaked with flood water generally are damaged beyond use and should be discarded. If necessary to use temporarily, scrape off surface dirt and expose to sunlight to dry as much as possible. Cover with rubber sheeting before using. A sufficiently valuable mattress or one of the innerspring type may be sent to a commercial renovation company where the stuffing will be taken out and cleaned, the ticking cleaned and resized, and the whole put together again in a mattress frame. Check cost of renovating against cost of replacement.

Feather and foam rubber pillows may be washed in automatic washers, but those stuffed with kapok or cotton may not. If ticking is in good condition, feathers and ticking may be washed together. Open a few inches of the seam in opposite corners of the pillow. Sew loosely by hand or fasten with strong safety pins. If ticking is in bad condition, transfer feathers to a muslin bag larger than the ticking. Sew up end and wash feathers in this bag. When using an automatic washer, do not overload machine — usually two pillows is a load. Use

the complete washing cycle, stopping at midway to turn the pillows by hand. If using a non-automatic washer, wash in lukewarm water 4 to 6 minutes, repeat, and rinse in lukewarm water several times. Squeeze out all the water possible. Sanitize according to procedures given under Clothing and Household Linens.

Feather pillows can be dried in an automatic dryer, but foam rubber pillows must never be. If pillows are dried on a clothesline in the open air and sun, which helps remove odors, change the position frequently, shaking vigorously to distribute the feathers evenly. It may not be possible to remove all objectionable odors from pillows.

Leather

Remove surface dirt from leather by rinsing with cold water, then wipe with a dry cloth. Stuff purses and shoes with crushed paper to retain shape. Leave suitcases open. Dry leather in normal air away from heat and sun. When dry, rub with saddle soap. Neatsfoot oil may be used on shoes that have become stiff; however, it causes leather to darken. Paste-type neutral floor wax may be used on leathers as a final polish if they are not to be refinished by a commercial cleaner.

Use fine steel wool (lightly) or a suede brush on suede.

Rinse leather and suede jackets in cold water. Dry away from heat.

To remove mildew from leather goods, wipe with a cloth wrung out of dilute alcohol (1 cup denatured or rubbing alcohol to 1 cup water). Dry in an airy place. If mildew remains, wash with thick suds of a mild soap or detergent, saddle soap, or a soap containing a germicide or fungicide. Then wipe with a damp cloth and dry in an airy place. Polish leather shoes and luggage with a good wax dressing.

Shoes contaminated with fungus growth on the inside often develop unpleasant odors, and variously colored growths show on the inner sole and linings and up into the toe. You can remove this kind of mildew with low-pressure sprays especially intended for freshening shoes; these sprays are available at shoe and department stores. Use these products as directed.

Another way to stop mold growth in leather goods is to place them in a container along with crystals of commercially prepared paradichlorobenzene-paraformaldehyde. Close the container tightly and allow the chemicals to vaporize. The vapors from these chemicals are effective in killing molds that have grown into leather, but they give no lasting protection against future contamination. As the vapors leak out, the chemicals must be replaced. Before using the shoes or luggage, air them thoroughly.

Valuable Papers and Books

Wet paper attracts mold and will continue to deteriorate until it loses its wetness. Separate sheets

of paper as soon as you can and allow them to dry in the air. Separate sheets not touching one another can be placed in a photographic print dryer, but care must be taken to prevent them from scorching.

Larger quantities of paper, such as in file cabinets, subjected to floods can be placed in a freezer to stop mold and deterioration. Separate into small bundles. When time allows, bundles can be removed, allowed to thaw, and individual sheets separated and dried. Do not try to unfold wet paper because it tears very easily.

Many stains can be removed from water damaged paper with nonsudsy household ammonia. Use it in a well ventilated place to avoid fumes.

Place books on end to dry and keep the leaves apart. If books are very damp, sprinkle cornstarch or talcum powder between the leaves to take up the moisture, leave for several hours, and then brush off.

After exposing books to the air for a time, pile and press them to keep the leaves from crumpling. Continue this alternate drying and pressing until they are dry to prevent mildew. Just before they are completely dry, apply a little heat between the pages to prevent musty odors.

Use a mildew inhibitor—paradichlorobenzene or paraformaldehyde - to stop mold growth.

Recording Flood Losses for Insurance and Relief Purposes

You should keep complete and accurate records, including photographs, of your flood property losses, structural and personal property damage, and the cost for replacement and rehabilitation or repair. Such records will aid you in the preparation of disaster relief (if available) and insurance claims and tax deductions. Disaster relief agencies, e.g., American Red Cross and its local chapters, can provide information regarding claim procedures and eligibility of claimants.

Obtain tax filing information from your Federal, State, and local Internal Revenue Service personnel because of the many variables encountered.

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SECTION 6

PLANNING AGAINST FUTURE FLOODS

The least effective time to plan for a flood emergency is during the emergency. If you live in a flood-prone area, emergency flood planning should be established and members of your household drilled in the procedures long before the emergency occurs.

PRE-FLOOD ACTIONS

There are certain preplanned actions you may wish to follow:

- * Investigate the feasibility of purchasing flood insurance. See Section 3.
- * Identify items to be evacuated with you.
- * Prepare a checklist of emergency supplies and equipment for combatting flood waters such as rope, plastic bags, sand bags, sump pump, buckets, etc.
- * List items to be relocated to a safer place in the order of their priority.
- * Identify vulnerable areas where sand bags should be placed.
- * Provide a circuit breaker or fuse chart with a list of those to be disconnected in a flood emergency. See Section 4.
- * List locations and emergency turn-off instructions for main gas, water, fuel tank, and sewer valves. See Section 4.
- * Tie up a boat where it is readily available but not subject to damage.
- * Write instructions for installing temporary shoring, bracing, or shear wall supports.
- * Provide instructions for opening or closing doors and windows at various flood levels. Describe location of stored closure panels.
- * Know destination and route to your evacuation point.

List telephone number of a person to be notified that you are evacuating and later that you have arrived safely. This provides knowledge that your home does not have to be checked for emergency evacuees and also the signal to notify authorities if you are unable to reach your destination.

BASEMENT STRUCTURES

It has been said that the best way to build a basement in a flood plain is - **DON'T**. If you must build a new home with a basement in a floodprone area, realize that it will require extra cost to provide the greater strength and waterproofing required. New basements in flood zones must be designed to withstand anticipated flood levels under local site conditions. This will in some cases require reinforcing rods in block or concrete walls and slabs as well as other design details.†

Footnote

†Anderson, Charles M., Manual for the Construction of Residential Basements in Non-Coastal Flood Environments, Federal Insurance Administration, Department of Housing and Urban Development, Washington, D.C. 20410

Flood waters subject basement walls to extraordinary hydrostatic pressures as described in Section 3.

There are two systems for protecting basements from flood waters - the sump and the barge. A third system allows water to flow into the basement. See Figure 6-1.

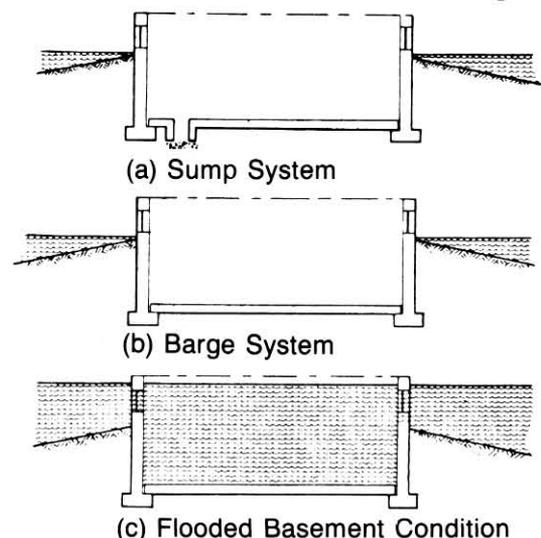


Figure 6-1

Basement Flood Water Control

Sump System

The first system uses a sump to collect and dispose of infiltrating water. Its philosophy is that any water infiltrating toward a reasonably built basement usually can be removed before damage is done. It utilizes the following steps:

1. Controls surface water to minimize the quantity of water impinging on basement surfaces.
2. Provides walls and slab built as waterproof as economically feasible.
3. Allows any water that would otherwise enter the basement to flow into a sump.
4. Reduces the hydrostatic head against the basement wall and slab by allowing water outside the wall and under the slab to flow through a drainage field of crushed stone or gravel into the sump.
5. Removes water from the sump by gravity drainage to a storm sewer or to the ground surface below the slab level if the house is built upon a slope. If gravity drainage is not available, a sump pump will be required. See Figure 5-2.

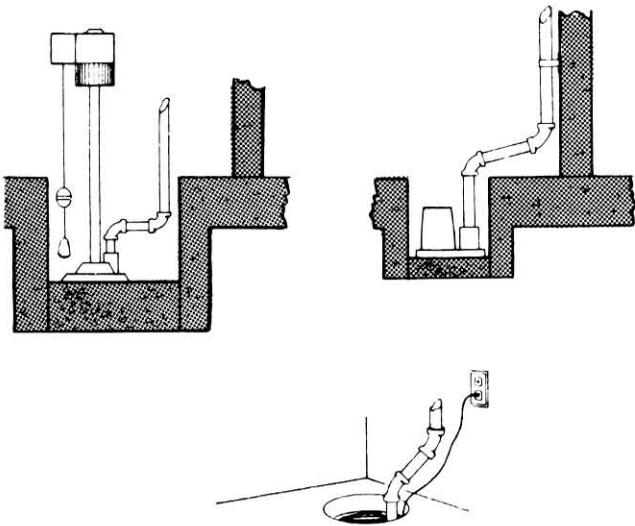


Figure 6-2
Sump Pump Installations

Application of the sump method is limited by the ability of the pump to remove water as fast as the maximum flood waters are inflowing. This requires a balance of pumping capacity with inflow, which is determined primarily by soil permeability.

Barge System

Although somewhat more costly, the “barge” system† is more effective than the sump system and is required in locations with conditions beyond the capability of the sump system. The barge is a basement designed to be watertight like the hull of a barge. Basement walls and flood slabs are designed to resist anticipated water and soil pressures. In addition, they are wrapped in a complete waterproofing envelope. It utilizes the following steps:

Footnote

†National Concrete Masonry Association, NCMA Tek 1, McLean, Virginia, 1970

1. Controls surface water to minimize the quantity of water impinging on basement surfaces.
2. Provides walls and slab designed and built to withstand the maximum anticipated flood level. This requires good design practice, high quality materials, extra care in placing and curing, adequate reinforcement, and proper supervision.
3. Encloses the flood slab and walls below grade with a watertight membrane. Some usable watertight membranes are prefabricated asphalt, asphaltic plastic, butyl rubber or neoprene panels, and elastomeric coatings. Parging, mopped tar, and other inflexible surface coatings cannot accommodate cracks in concrete and therefore do not provide a positive seal. Uncoated concrete of exceptional quality can be made watertight. This, however, requires commercial practice sometimes not used by residential concrete contractors. In addition, concrete admixtures or intercrystalline treatment can provide watertight concrete. If a quality watertight membrane is not used, waterproofed control joints are required to take care of the cracking common to concrete.

Strength of Walls and Slabs

Some basements are constructed to less than generally accepted specifications. The National Concrete Masonry Association recommends that hollow load-bearing concrete block basement walls have the following maximum depth below grade:

Maximum Height of Moist Dirt

Fill Outside Basement Wall

5 feet

6 feet

7 feet

Nominal Thickness of Unreinforced

Hollow Block Wall

8 inches

10 inches

12 inches

Basement walls that are built to specifications less than code are marginal in their resistance to excess water pressures.

Even a professional engineer labors under a disadvantage when trying to evaluate an existing basement structure if the specifications are not available. The quality of concrete is difficult to determine. The presence and location of reinforcing steel in walls and slab may not be known. Other variables such as flood levels and soil permeability complicate evaluating the adequacy of basement structure.

Older basements may have been "field tested" by previous years' floods, but the effects of an unusually heavy flood are still unknown. If basement walls are of questionable strength to resist flood water build-up, the problem may be reduced in several ways:

1. Allow water to enter basement to equalize water pressure on both sides of basement wall and floor.
2. Apply shoring to help support long spans of basement wall. Shoring may be either emergency, removable, or permanent. (See Figure 6-3.) Shoring installations should be individually designed by a structural engineer for each basement.

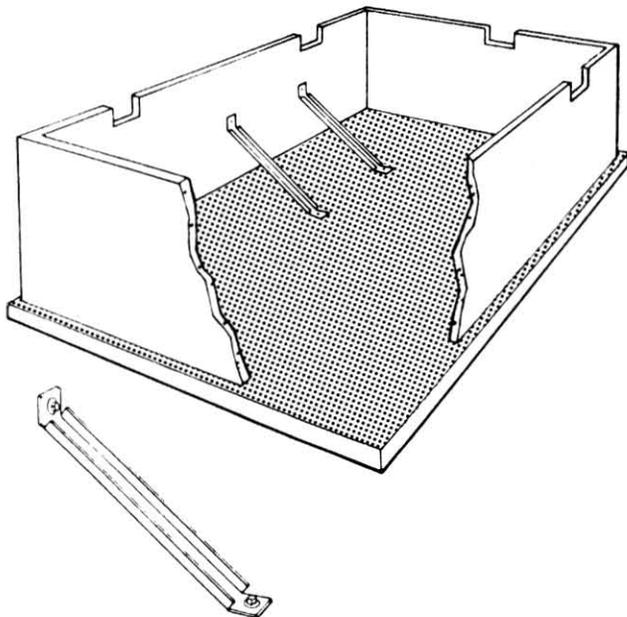


Figure 6-3
Wall Shoring

3. Install shear partitions that intersect and support midspan sections of basement walls and floors. A shear partition is a plywood-sheathed 2x4-framed wall fastened to the basement wall, slab, and floor above. It extends at least 4 feet in from the basement wall (See Figure 6-4.). See a structural engineer.

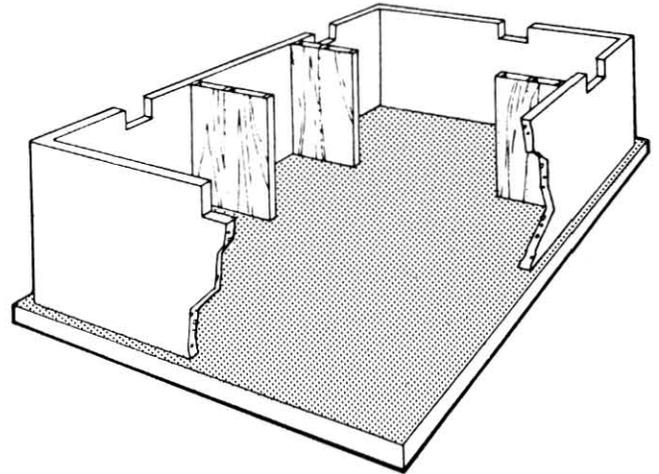


Figure 6-4
Shear Wall Supports

Pilasters may be designed into new cast concrete or concrete block basements as shown in Figure 6-5 to provide additional lateral support for the walls. See a structural engineer.

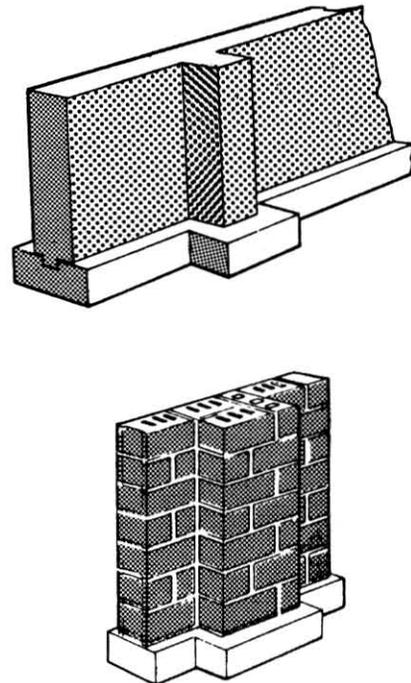


Figure 6-5
Pilasters

BASEMENT FLOOR BLOW-OUT PLUGS

Water pressure against the bottom of a basement flood is highly variable. If water were able to migrate down the wall freely and extend across the entire bot-

tom surface of the floor slab, a water level less than a foot above the bottom surface of the slab could rupture a 4 inch-thick unreinforced concrete floor. Local reduced soil permeability, however, sometimes will not permit migration of water to the entire bottom surface. Dry soil will not apply hydraulic pressures to the slab. Installing a blow-out plug or a built-in breakaway panel decreases, but does not preclude, the chance of a slab's structural failure because of unknown soil and structural variables.

The need for a blow-out plug should be based upon an engineering evaluation of the chance of failure and should consider soil permeability, basement structure, and anticipated flood levels. If heavy leakage is anticipated around the periphery of the basement where floor meets walls, sufficient pressure relief may be gained by this infiltration of water into the basement. If the plug-section were weakened by sawing part-way through the slab, the plug would not likely blow out through shear failure of the concrete until long after the slab is destroyed by bending across its wide span. A 1-foot-square concrete plug should be completely removed intact from the slab by cutting it with a diamond saw. See Figure 6-6. Treat the underlying surface of the plug with asphalt or tar to reduce capillary action. Fill saw over-cuts with asphalt. After you replace the concrete plug, use tar or asphalt 1 inch-deep into the crack around the plug to seal the joint.

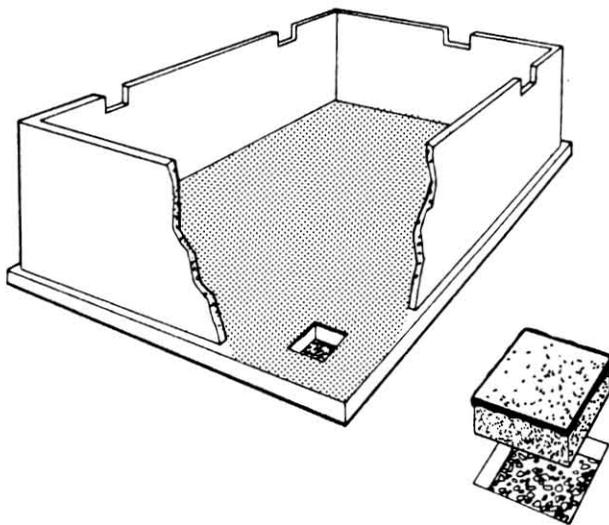


Figure 6-6
Floor Pressure Plug

Footnote

Shear: the stress force caused by opposing forces that almost meet head on. In the case of a basement wall, the pressure force of earth backfill and any hydrostatic pressure of flood waters, is opposed by the forces of intersecting walls, flood slabs and overhead floor framing which support the basement wall in resisting soil and water pressures.

The plug is best located near a corner of the basement to reduce structural weakening. It should be in an unloaded floor area and where intruding water through the blown plug will not endanger persons or property.

LEAKY BASEMENTS

Basement walls built with cast-in-place concrete and concrete masonry block and cast-in-place concrete floors are subject to cracking. Most of these basements are "waterproofed" by spreading a plastic concrete parging layer over the exterior wall. This is often covered with a hot- or cold-applied bituminous coating. When the concrete structure cracks, these coatings are usually incapable of bridging the crack and leave the structure open to leakage. It is an expensive undertaking to remove the backfill soil and recoat exterior walls; impossible to coat the exterior of floor slabs. Interior coatings are used to seal off leaking areas, but they are seldom capable of sealing existing or future cracks.

An intercrystalline treatment is capable of sealing the inside of an unpainted concrete or block basement to a depth of several inches. It will accommodate small cracks up to 1/32-inch wide. Larger cracks can be treated and then patched. The intercrystalline treatment is capable of "curing" small cracks as they develop.

Many builders have satisfactorily used gravel under-drains under the slab, drain tile, and polyethylene sheet on wall exteriors and slab bottom.

If flood levels remain below the basement windows, the only water infiltration into the basement is by seepage through walls or floor or through structural fractures. If a significant head of water is standing outside the basement walls, water is literally probing each square inch of structure for a means of entry. In addition, the head of water is applying a constant pressure to fracture the basement structure.

Unless the basement is equipped with gravity drains to daylight or to a storm sewer, it will usually be necessary to remove leakage water. This may be done by bailing with buckets and by mopping; but it is far easier to accomplish with a pump.

Pumps are designed for either portable or permanent installations. Permanent pumps are usually mounted in sumps which provide a basin for accumulating water. Examples of these are shown in Figure 6-2. Portable pump operations is improved if a sump, even a very shallow depression, has been provided in the lowest part of the basement floor. See Figures 6-7 and 6-2.

Pumps are driven by electric motors or gasoline engines. The gasoline driven pump has the advantage of not being vulnerable to power blackouts which are frequently experienced during storms. However, gasoline-driven pumps require outdoor ventilation to avoid the possibility of carbon monoxide poisoning. Bilge pumps operate on a 12-volt direct current, are available from boating suppliers, and can be operated

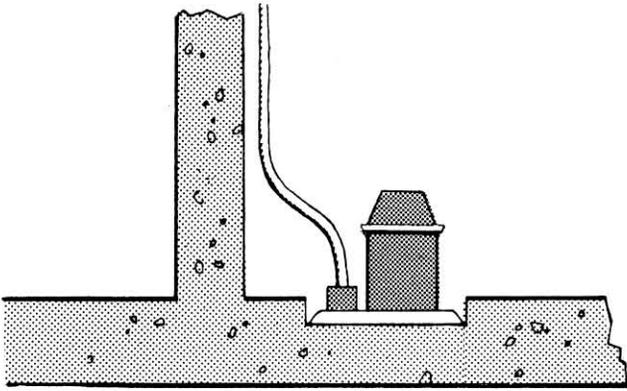


Figure 6-7
Shallow Sump

from an automobile electrical system.

Pump bearings determine the manner in which the pump can be used. Many pumps require water for bearing lubrication and should not be operated when no water is being pumped. This type of pump can be controlled manually or by a float switch to ensure that it is operated only when there is water to be pumped.

If the home owner believes that the sump pump will not keep the basement dry, he might consider moving furnishings and electric motors, and appliances up to the first floor. **CAUTION:** The floor may not be able to safely support the additional weight of heavy equipment or furniture.

BUILDING HOMES IN FLOOD ZONES

Sites in low level flood zones can be protected by elevating them with well compacted earth fill on which basementless structures can be built.

In high flood zones homes may be raised a full story on sturdy pilings. The area below can be left open, or it may be enclosed with breakaway panels designed to collapse under the impact of onrushing waters leaving only the pilings in the flood waters.

Your building material dealer can supply water resistant materials that can be used in flood prone sections of your home. Some of these include:

- * impermeable sheet insulation
- * water resistant paints
- * water resistant flooring materials
- * water resistant adhesives
- * water resistant carpeting
- * exterior type plywood with waterproof glue line or interior type with exterior glue
- * water resistant doors and windows
- * water resistant cabinets

Wood frame construction subject to flooding can utilize commercially available pressure-treated lumber

to improve resistance to fungus-caused rot. On the other hand, existing structures may be surface-treated with commercial preservatives such as "Wood Life" (pentachlorophenol), "Cuprinol" (copper sulphate), or others of similar content but, these are less effective than pressure treatment. Wood preservatives are toxic and children should be kept away from them. Read label cautions carefully before applying preservatives.

Basements

Basement floors are usually more susceptible to structural failure than walls under flooded conditions. Basement floors are usually made with 4 inch-thick concrete without reinforcement (Wire mesh is intended for crack control, not reinforcement.) A slab may resist water pressure over its entire surface equivalent to the highest pressure acting on any wall section. Couple this pressure with wide unsupported spans, often 20 feet or more, and the floor is frequently the first part of the structure to fail. Basement floors in new homes may be strengthened by reinforcing, post-tensioning, or using intermediate structural walls designed for floor support.

Subsurface water flow can be impeded if newly constructed basements are backfilled with material having a high clay content. Clay is relatively impervious to water, but expansive clays can put additional swelling pressure on the wall.

Existing basements usually require engineering analyses to adequately "beef up" the floor slab. Some basements have built-in breakaway wall panels or floor plugs that are intended to give way and allow water to enter before critical structural failures are reached. See Figure 6-6.

If a basement or ground floor is subject to flooding, equipment located in that area may be raised to a level above normal flood level. For example furnaces, air conditioning units, hot water heaters, cabinets, and freezers may be permanently raised to a higher level or at least mounted a few inches above the floor to raise them above the expected infiltrating water level.

The width of interior basement stairways, clear of the handrail, should be at least four feet, and the minimum dimension of the landing at the head of the stairway should be at least 42 inches, to facilitate relocation of basement contents in the event of impending flooding. The added space will permit relocation assistance by children and other persons having minimal physical strength.

Positive drain openings may be built into basement ceilings and duct work to avoid collapse due to the weight of retained water.

A positive sill anchor (Figure 6-8) will assure that the house remains secured to the basement.

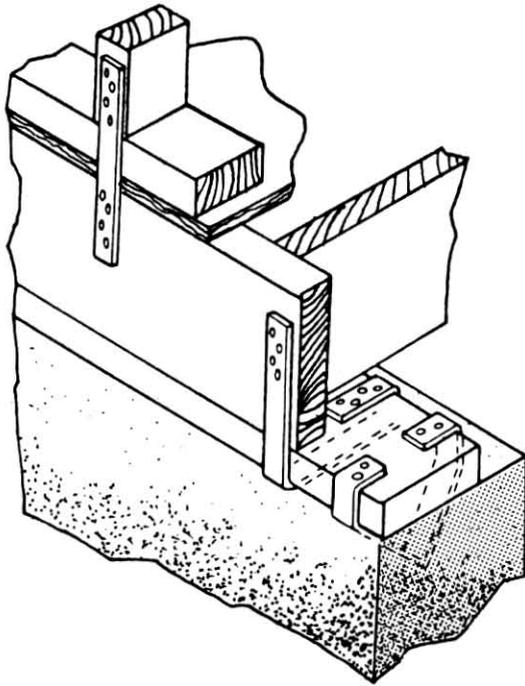


Figure 6-8
Positive Sill Anchors

Utilities

Electrical distribution boxes are usually located so as to minimize lengths of cable runs or to get the boxes out of sight. Either approach frequently puts the boxes in the basement, where they are most vulnerable to flood water damage. On new construction, locate electrical meters, distribution boxes, outlets, and as much wiring as possible above the maximum flood level. Switches, outlets, or wiring below maximum flood level can be isolated on flood-vulnerable circuits. These circuits should be plainly marked in the circuit breaker box so they may be turned OFF before they are exposed to flooding. There is at least one exception to this rule—a submersible sump pump would preferably be fitted

with submersible wiring below the flood level so that the pump can still be used under flooding conditions.

Drainage facilities should be built into flood-prone installations: Gas pipe runs can be sloped a minimum of 1/8 inch per foot and drain plugs installed at low points. Electrical conduit should be sloped toward drained low points.

Fuel tanks inside the building should be anchored securely to prevent them from floating or overturning. Fuel tanks should be vented to the exterior above the normal first floor eaves level to prevent the escape of fuel into the flooded house with consequent saturation of structure, rugs, and furnishings. Outside fuel tanks also should be well anchored to resist buoyancy or overturning.

To prevent sewage backflow from the main sewer line during a flood, two principal types of backflow valves are used - the check valve, sometimes called a backwater valve (Figure 6-9), and the gate valve (Figure 6-10).

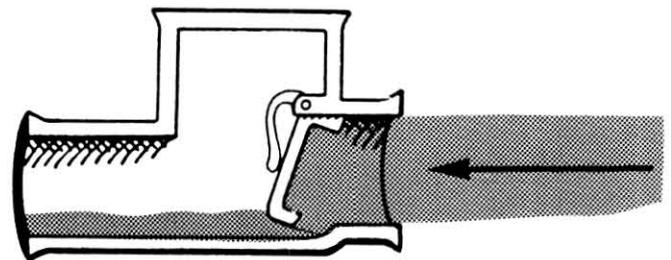


Figure 6-9
Check Valve

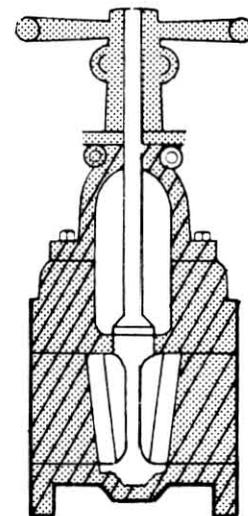


Figure 6-10
Gate Valve

A check valve will permit sewage to flow outward but will not allow backflow. Unfortunately, a check valve requires frequent cleaning and maintenance to remain effective. This maintenance is beyond the ability of the average home owner. Consequently, the reliability of a check valve for residential use is open to question.

A gate valve is a manually operated valve which shuts off backflow and simultaneously shuts down the entire house sewer system. It does not require the frequent cleaning and maintenance of a check valve.

A third type of valve combines the check valve with a manually operated gate valve. This provides automatic check valve protection combined with the positive operation of the manual gate valve. This dual option may be expensive. See Figure 6-11.

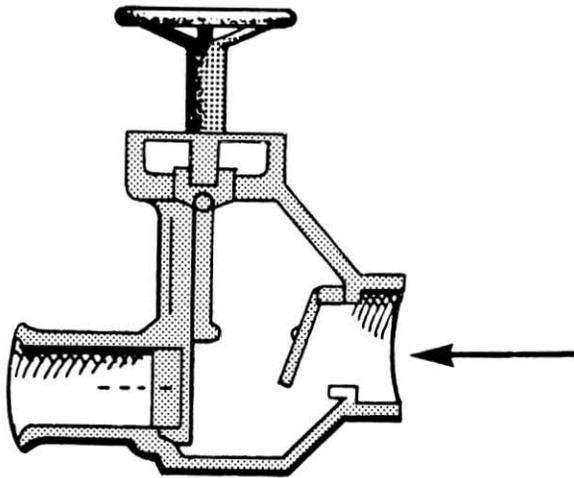


Figure 6-11

Dual Backflow Valve

DIVERSION OF WATER

Flood water can be kept from your home by diversion, blocking, or both. Any structure built to block or divert flood water must be designed by a structural engineer competent in the subject. Construction must be supervised carefully to ensure the design is carried out completely. Some structures suitable for diverting or blocking flood water and its debris follow:

- * Barriers can be built to divert water away from the house. Such structures built into fences, decorative rock gardens, or planters can add to the attractiveness of the home. If the diverter is intended to control rapidly flowing water, it should be angled in the direction the water is to flow surrounding a home.

- * A wall with openings designed for inserting flood gates can be built to protect the entire structure. Flood gates can be inserted in the openings to close them off during floods.

- * A wedge-shaped building unit attached to the structure facing the oncoming flood path can divert flood waters sufficiently to avert structural damage.

- * Guard rails, similar to those used on highway median strips and shoulders, can divert floating debris away from the house. They help to protect against ramming by large trees, floating structures, and other large objects. A guard rail angled to divert floating debris will require considerably less structural strength than one designed to stop the debris.

- * A wall can be built around outside openings leading to a lower level of your home. As an example, a stairway leading to a basement protected with a properly constructed and sealed concrete block wall and a watertight bulkhead plate to seal off the opening during a flood would provide excellent protection. Reinforcing rods and concrete grout placed in the cores of the blocks will help to strengthen the wall. Use material similar to the original construction to permanently close off any unnecessary basement window if basement will not be intentionally flooded to reduce pressures, or place latching window shutters across the outdoor-side of glass windows to reduce the likelihood of damage from floating debris and water pressures.

- * Replace necessary basement windows and provide light and ventilation by using a commercial grade window with small glass panes in a steel sash. Glass block allows the passage of light only.

- * Equip windows and doors with removable cover plates to be put in place when flooding is expected. These covers may have non-watertight edges as shown in Figure 6-12. This illustration shows a plywood panel that is easily mounted or removed in wood or metal channels. It is useful for protecting against floating debris. If a watertight panel is required, it can be nailed, screwed or bolted to the window or door frame and carefully caulked around the edges. If panels are nailed, the use of double-headed duplex nails will facilitate later removal.

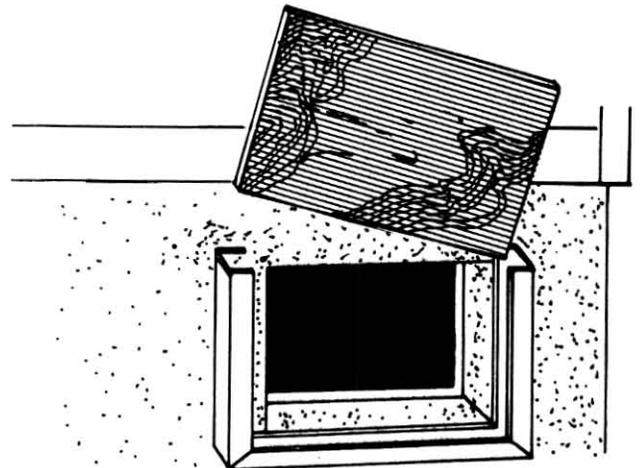


Figure 6-12

Removable Window Cover Plate

If water is to be allowed entry, scribe a line on the interior of each basement windowpane two inches above and parallel to the bottom edge of the glass and extending between points two inches from the vertical edges of the pane. This will reduce the hydrostatic pressure required to break the glass and flood the basement. In this way, potentially dangerous hydrostatic forces may be counterbalanced by interior water loads. Reduce the visibility of the scribed line by filling it with dark-colored paint. Double-glazed windows should not be scribed.

EROSION CONTROL

Erosion of backfill soil can expose the subsurface building structure to direct effects of moving flood waters. It can also undermine the bearing soil supporting foundations or floor slabs. Soil erosion can be reduced by several methods:

Contouring

The surface can be contoured to improve drainage and minimize flood water turbulence by adding well-compacted earth fill and cutting.

Diverting

Walls, berms, or ditches can divert flood streams away from vulnerable areas. Berms can also surround a site to create a small levee.

Sodding

Ground covers or grasses, especially those with fibrous root systems, can hold soil against the erosional effect of flood waters. Ask your Agricultural Extension Agent for recommended plants in your area.

Covering

Concrete or masonry retaining walls, stone riprap, paving or temporary plastic sheeting can protect small areas of soil against flooding.

INSURANCE CONSIDERATIONS

There is a Federal Government Program available to help you minimize financial risk from floods, the **National Flood Insurance Program**.

Pay a visit to your City Hall or Municipal Building and find out whether your community is participating in the National Flood Insurance Program, and if the answer is yes, how and by whom the Program is administered in your community.

Ask to see a Flood Hazard Boundary Map or a Flood Insurance Rate Map. Most flood prone communities in the United States have at least a Flood Hazard Boun-

dary Map on file. This map will show you whether your home is located within the 100 year flood plain. Property located at the 100 year flood level has one chance or greater in one hundred (1 percent) to be flooded in any one year. If your home is at or below this level, it would be advisable to buy flood insurance.

If your community is participating in the National Flood Insurance Program, call your insurance agent and ask him to obtain this flood insurance for you. Your agent can give you detailed information on premiums and coverage available for both structure and contents of your home.

If your community is not participating in the program, you, as an individual, cannot buy Federal Flood Insurance. It will be necessary to alert your neighbors and create sufficient interest in the Flood Insurance Program in your community to induce the authorities to enter the Program.

Your community's participation in the flood insurance program is extremely important, because if, at the time of a future flood, your community is not participating, you may not only have no insurance, but you may even be denied disaster relief for insurable structures.

If the Flood Insurance Rate Map is available, you can predict how high the water might reach into your home by comparing the ground elevation shown on the map near your address. The elevation of the base flood (a flood having 1 percent probability of occurring in any one year) is shown as a figure between two wavy lines or as a marking, EL. XYZ MSL (MSL means mean sea level.)

If the flood elevation shown is higher than your ground elevation, you have to expect some flooding. Depending on how large the difference is, you can expect basement flooding or first floor flooding, and you can determine whether second floor (if any) will be safe for people and for property storage. It is advisable to mark the base flood elevation at an inconspicuous place on a wall. You can then compare it to the flood heights predicted in flood warnings.

The base flood elevation will also help you to determine where to seek emergency shelter and the best dry route to get there. Compare the flood elevation to the elevations shown on a U.S. Geological Survey (USGS) topographical map.

If a Flood Insurance Rate Map is not available in your community, compare the flood level stages on a nearby river gauge with the elevation of your property and inquire about known historical floods and the elevations they reached.

SECTION 6

REFERENCES

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