MAKING BASEMENTS DRY

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Making Basements Dry

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A dry, light basement can provide space for a storage, workshop, laundry, or recreation room, or for additional bedrooms. It can lengthen the life of the house and furnishings, and add greatly to the value of the house.

Basements should be made watertight at the time of construction. Correcting wet or damp conditions after construction is completed can be very difficult and expensive.

To build a dry basement or to correct wet or damp conditions in an existing one, you must be familiar with the causes of wet or damp basements. The possible sources of water or dampness must be determined before work is begun in order to take the measures necessary to insure a dry basement.

CAUSES OF WET OR DAMP BASEMENTS

There can be many causes of wet or damp basements. The trouble can be minor, readily apparent, and easily corrected. Or, it can be a more serious condition, not readily detected from the surface and hard to correct. Test borings to determine the subsurface or ground water level should be taken during the wet season.

Following are some of the more common causes of wet or damp basements:

- The land is flat or slopes toward the house, permitting surface water (rain and melting snow) to drain down against the basement walls. Water leaks through cracks or other openings in the walls and causes wet spots on the walls or floor or standing water on the floor in corners and along the junction of walls and floor.

- No gutters and downspouts (or defective ones) to handle roof water from rain and snow. The free-falling water forms puddles or wet soil near or against the basement walls. Water leaks in or enters by capillarity.

- The subsurface or ground water level is close to the underside of the floor slab. Water rises through the slab by capillarity, producing dampness.

- The subsurface or ground water level is higher than the basement floor. Water leaks in or enters by capillarity, causing standing water in the basement and, at times, dampness in the rooms above.

- Condensation ("sweating") of atmospheric moisture on cool surfaces—walls, floor, cold-water pipes—in the basement.
- Leaky plumbing or other sources of moisture increase the humidity of the basement air. Dense shrubbery and other plantings around the basement walls prevent good ventilation.

SELECTION OF BUILDING SITE

An important consideration in selecting the site for a new house is proper drainage. This includes not only drainage of surface water, but also drainage of any subsurface or ground water that may be present or that may accumulate over a period of time and be blocked from its normal course of flow by the new construction.

The highest point on the property is the best site (fig. 1, *A*). It will provide the best surface drainage away from the house in all directions, and the subsurface or ground water will be at the greatest depth.

Second choice might be a sidehill location (fig. 1, *B*). The advantage of such a location is that drainage water can be routed around the high side of the house for runoff at the ends and low side.

If the site is flat, the ground around the house must be built up or graded to drain surface water away from the basement walls (fig. 1, *C*).

The surface soil and subsoil should be open and porous so that air and water are admitted readily. Desirable soils include sands, loams, and gravels, all of which provide good, deep, natural drainage. Under ideal conditions, the soil is so well drained that during the rainy season the subsurface or ground water level is at least 10 feet below the finished grade. Water at that level is well below the level of the average basement floor.

ROOF WATER

Houses should have gutters and downspouts to take care of roof water from rain and snow. Keep the gutters and downspouts free of debris. Where leaves and twigs from nearby trees may collect in a gutter, install a basket-shaped wire strainer over the downspout outlet. Repair gutters and downspouts as soon as the need appears. Keep them painted.

Downspouts usually have an elbow or shoe on the lower end to discharge the water slightly above the ground and away from the basement wall. To prevent concentration of water at the point of discharge, use a concrete gutter or a splash block to carry the water away. The gutter or block should slope 1 inch per foot, and its edges should be flush with the grade.

Disposal of roof water as shown in figure 2 makes it easy to clear clogged downspouts. Roof water can also be piped underground to a storm water drain, dry well, or surface outlet, 15 feet or more from the house (fig. 3). The bottom of a dry well should be lower than the basement floor and in earth or rock that drains rapidly.

SURFACE DRAINAGE

Basements can become wet or damp when surface water drains down against the walls. Drainage

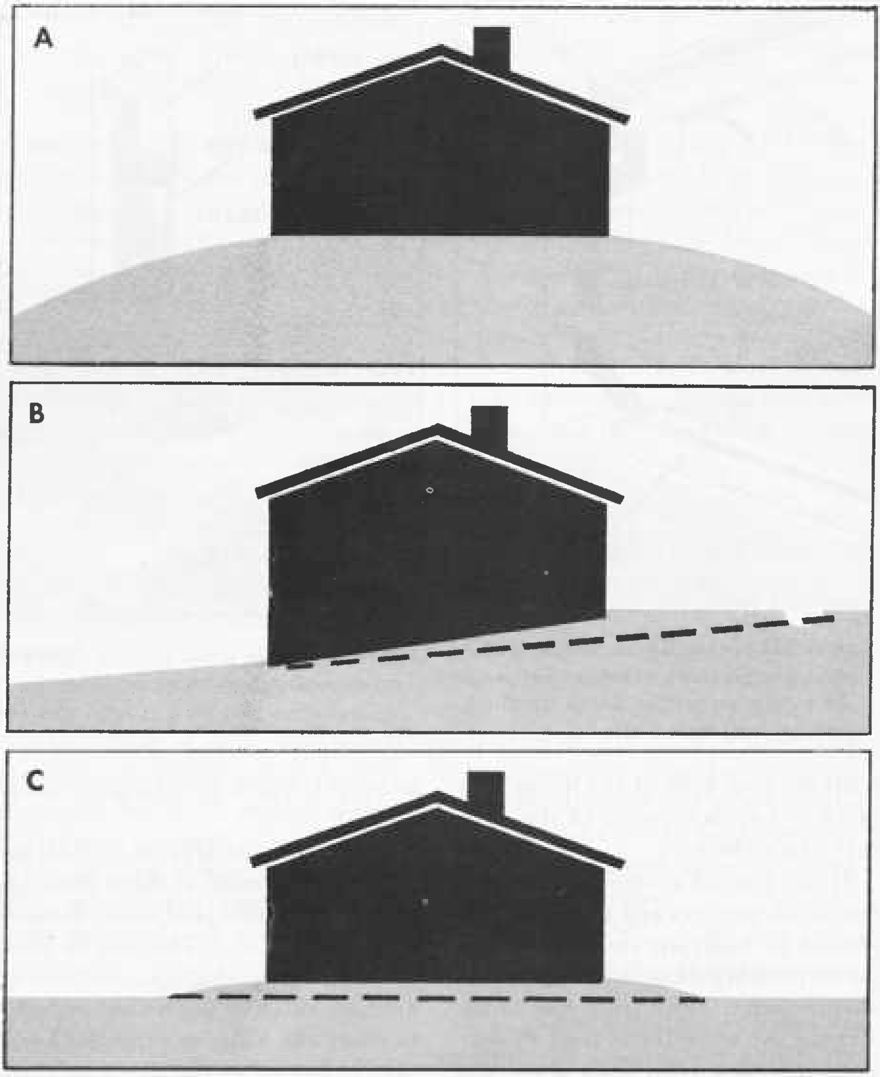

Figure 1.—House sites: *(A)* An elevoted site pravides gaad surface drainage away from the hause in all directians. *(B)* Drainage can be rauted araund a sidehill-locoted house (nate drainage ditch an uphill side). *(C)* On a flat site, the graund araund the hause must be built up to drain water away fram the bosement wolls.

down the walls cannot be prevented, but should be minimized.

After a basement is built, the excavation around it is usually filled with loose dirt. To make this dirt less permeable to the passage of water, it should be free of pieces of masonry, mortar, and other waste material, and should be compacted as it is put into the excavation.

CAUTION: Do not backfill against concrete masonry basement walls

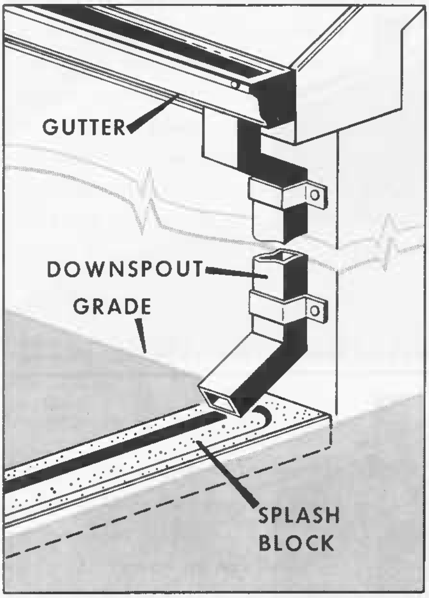

Figure 2.—Correctly installed gutters and down-spouts prevent roof water from forming wet or damp conditions around basement walls.

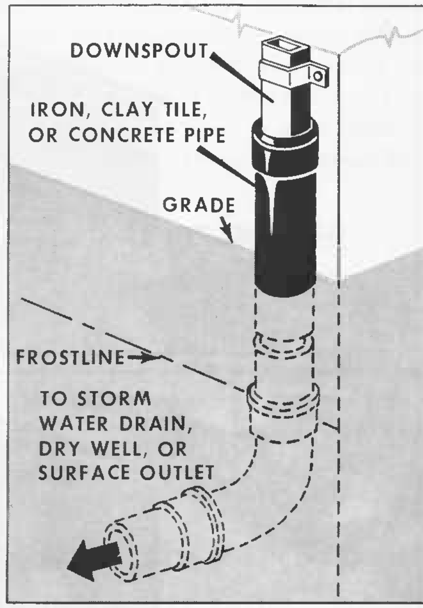

Figure 3.—Roof water can be routed to a storm water drain or other outlet.

until the first floor of the house is in place. Any movement of the walls may crack them.

If the ground around the house is flat or slopes toward the house, it should be built up and graded to a smooth, sharp slope that will drain surface water away from the house. Extend the slope for at least 10 feet. Seed it with a good lawn grass, and rake and roll it. Sodding is a common practice and prevents the washing away of a newly graded area during heavy rains.

If possible, the basement windows should be entirely above the finished grade for maximum light and ventilation (at least 8 inches from the grade to the top of the window sill). Windows or parts of windows that must be below grade should be protected by metal or masonry window wells. The bottom of a well should be gravel, which permits good drainage.

Where a large area of land slopes toward the house, surface drainage should be intercepted some distance from the house. This can be done by digging a shallow, half-round drainage ditch or depression designed to route the water around the house (fig. 1, *B*). Sod the ditch or plant grass. If a ditch is objectionable, draintile, with one or more catch basins at low spots, may be installed.

SUBSURFACE DRAINAGE

Deep, thorough drainage of the house site is important. In poorly drained soil or where the basement will be below the subsurface water level, draintile should be installed around the footings or at least on the side or sides where trouble may occur (figs. 4 and 5). This drain should be installed even though the walls and floor receive special waterproofing.

Good, 4-inch draintile should be used. It should be laid parallel with, and at the bottom of, the footings. *The bottom of the tile must not be lower than the bottom of the footings. If the drain is below the footings, the footings may be undermined.* The drain should slope very little—about ½ inch per 12 feet. Joints between sections of the tile should be open about the thickness of a knifeblade, and the top half should be covered with building felt or similar material to keep out dirt.

In normal, porous soil, the tile should be covered with 18 inches of screened gravel. In heavy, nonporous soil, the gravel should extend almost to the top of the excavation. In either kind of soil, fine gravel should be placed immediately over and around the tile to provide a good bedding and protection.

This footing drain and belt of gravel around the basement walls should drain off all seepage water and prevent the accumulation of water around the walls. This method is especially suitable on the upper side of a house located on a hillside, because a drainage outlet can usually be located within a short distance.

Under abnormal conditions, it may be necessary to drain deeper than the foundation. The draintile should be placed 4 to 5 feet away from the footings to prevent undermining them. Branch drains may be laid to take care of any springs that may appear when the excavation is completed.

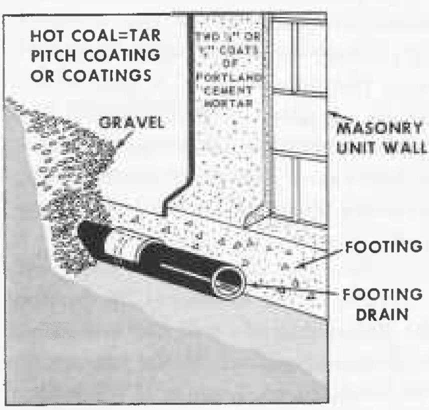

Figure 4.—A footing drain prevents the accumulation of water around basement walls.

WALL AND FLOOR CONSTRUCTION

Construction required for the basement walls and floor depends largely upon soil drainage conditions. In well-drained soil, good, water-resistant construction may be adequate. In poorly drained soil or where the basement floor will be below the subsurface water level, watertight construction is required.

General Construction

Cost and availability generally determine the material of which the walls will be built. Poured concrete and hollow-masonry units are most commonly used.

In well-drained soil, concrete that is properly mixed, placed, and cured should provide sufficient protection against moisture penetration.[1] Hol-

[1] Farmers' Bulletin 2203, "Use of Concrete on the Farm," gives detailed information on mixing, placing, and curing concrete. If you wish a copy, send a post card to the U.S. Department of Agriculture, Washington, D.C. 20250.

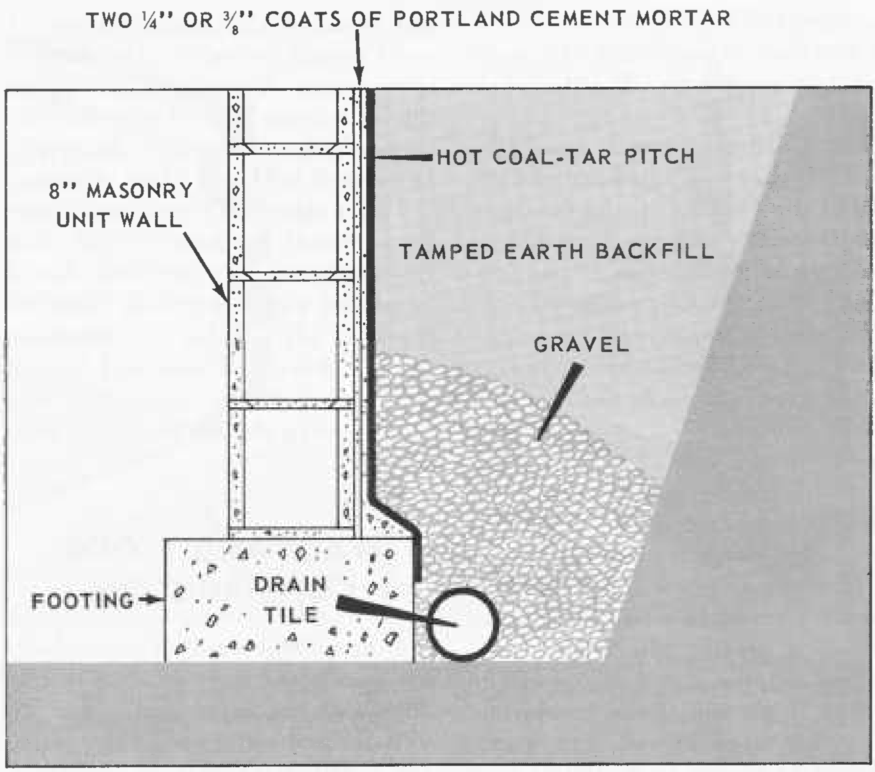

Figure 5.—Woterproof construction of mosonry unit wolls. In very poorly droined soil, the grovel should extend olmost to the top of the excovotion.

low-masonry unit walls should receive two ¼- or ⅜-inch coats of portland cement mortar to help shed water down the walls and keep it out of joints. Application of the mortar, which is called parging, is discussed on page 9.

The walls should have, or should be started on, substantial concrete footings. Properly designed footings prevent uneven settlement and possible cracking of the wall.

The floor should be an even concrete slab about 4 inches thick. A vapor barrier of polyethylene or 55-pound roll roofing should be placed under the slab.

The floor should have a slight slope in one or two general directions to aid in the removal of water that may enter the basement. A floor drain can be installed to drain water, and will be useful for draining appliances or fixtures. The floor should slope toward a floor drain from all directions.

Depth of the basement floor below the finished grade will be established by house design. Deep basements are likely to be damper than shallow ones, but the temperature tends to be more uniform as the depth increases.

The basement should have enough windows for adequate light and ventilation. And as indicated in the section on "Surface Drainage" (p. 2), for maximum light and ventilation, all windows should be above grade.

Watertight Construction

Poured concrete is recommended for watertight construction of the basement walls and floor, but hollow-masonry units are often used for the walls.

Choose one of these methods of waterproofing:

- Close, compact, watertight construction of the walls and floor themselves. This is called the integral method and is applicable only to poured-concrete construction.
- Application of a bituminous membrane to the exterior surface of the walls and under the floor slab.
- Application of two coats of portland cement mortar to the exterior surface of the walls. This is called parging.
- Application of polyethylene film, a vapor barrier material, to the exterior surface of the walls. Manufacturers' instructions should be followed in applying the material.

Integral Method

Good materials (cement, sand, and gravel) and first-class workmanship are essential for watertight concrete. Follow these general instructions in building the basement walls and floors:[2]

- Do the work in mild, dry weather. Fall is the best time, because the subsurface water level is usually low and temperatures are more favorable for making watertight concrete.
- Use fresh portland cement; clean, coarse sand; clean, sound gravel not over ¾ inch in diameter; and the smallest quantity of water that will give a smooth, workable mix. Do not use more than 6 gallons of water per sack of cement.
- Mix the concrete thoroughly. Thorough mixing increases the strength and watertightness.
- Pour the floor in one continuous operation and the walls in as nearly a continuous operation as possible. Leakage can occur at construction joints and at seams between pourings.
- Work (vibrate or spade) the concrete in the forms only enough to eliminate honeycombing. Overworking it can cause a nonuniform mixture and reduce its strength and watertightness.
- Properly protect and cure the concrete immediately after placing it. Freezing or rapid drying of the concrete by sun or wind can damage it and make it worthless.

Figure 6 shows under-the-floor construction details. In compact or clayey soil, lay a 5-inch layer of compacted gravel. Follow with a 1-inch layer of tamped sand. Cover the sand with a vapor barrier such as polyethylene or 55-pound roll roofing. Pour the floor slab on the vapor barrier. Be careful not to break the material, because it will be ineffective at that point.

In very poorly drained soil, lay a 4-inch layer of clay tile or hollow-masonry units. Follow with the vapor barrier.

Roll roofing vapor barrier (but not polyethylene) should be turned up

[2] See footnote 1, p. 5.

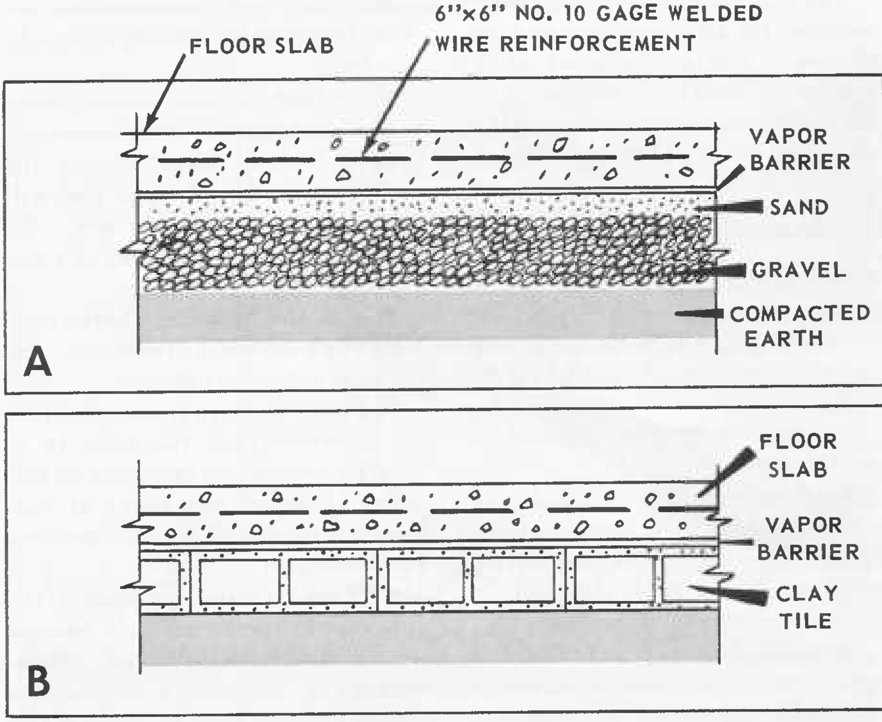

Figure 6. —Woterproof construction of bosement floor in compoct or cloyey soil *(A)* ond in very poorly droined soil *(B)*.

on the inside surface of the basement walls. A 1-inch space, formed as shown in figure 7, should be left between the floor slab and walls. After the slab has cured, the two pieces of siding are removed and the space is fillcd with hot coal-tar pitch.

Membrane

Overlapping layers of a prepared waterproofing felt or fabric are applied to the exterior surface of the walls and under the floor slab. The layers are coated and cemented together with hot coal-tar pitch.

The wall surface should be smooth, clean, and dry. Fill in holes and depressions with mortar. Knock off projections that could puncture the membrane. A coat of cement mortar may be applied over the membrane to protect the exterior surface against abrasion and puncture.

The floor membrane may be laid on a thin concrete subfloor or over hollow-tile or concrete units covered with a coat of mortar. The membrane should be turned up against the inside surface of the walls. After the floor slab has cured, the space between it and the walls is filled with hot coal-tar pitch.

If properly applied, the membranc is a very effective method of waterproofing. However, it is one of the more expensive methods, and, if leaks develop, they may be difficult to locate and costly to repair.

Parging

Two ¼- or ⅜-inch coats of portland cement mortar are applied to the exterior surface of the walls (fig. 5). The mortar should be mixed in the proportion of 1 part portland cement to 2½ parts sand.

The wall surface should be thoroughly cleaned to remove dirt and loose material. Just before the first mortar coat is applied, the wall should be moistened and given a brush coat of neat portland cement grout. The second mortar coat should be applied before the first one sets hard, and the first one should be lightly scratched with a stiff brush to obtain good bond between coats.

The surface of the second, or outside, coat should be steel-troweled to a smooth, impervious finish. Do not overwork the surface.

In very wet soils, the parged wall surfaces below grade may be given two coats of hot coal-tar pitch. The mortar must be dry when the coal-tar pitch is applied.

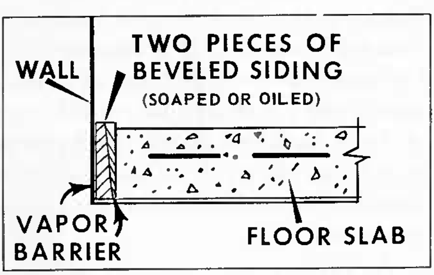

Figure 7.—The 1-inch joint between the bosement wolls ond floor is formed with pieces of siding. After the floor slob hos cured, the pieces of siding ore removed, ond the joint is filled with hot cool-tor pitch.

CAUTION: Any movement or other disturbance to the walls can crack the walls and mortar coating. Do not backfill dirt against the walls until the first floor of the house is in place.

CONDENSATION

Condensation is a frequent cause of dampness in basements. It occurs when moisture in the basement air condenses on cool surfaces—walls, floor, cold-water pipes. It may be prevented or eliminated by preventing or removing excess moisture in the air.

Avoidable sources of moisture, such as leaky plumbing, should be eliminated. Exposed cold-water pipes should be insulated.

The basement should be well ventilated—sunlight and free movement of air can quickly dry out a basement. Trees and shrubbery around the basement should be pruned or thinned out to prevent heavy shading and to permit better air circulation.

Ventilation should be governed by weather conditions. In general, windows should be open night and day during fair weather and when it is cooler outside than inside the basement. During hot, humid weather or long rainy spells, windows should be closed because the outside air will probably contain more moisture than the basement air.

Laundering is the most common cause of excess humidity in basements. Washing clothes and drying them either on lines or in a mechanical dryer adds considerable moisture to the air. This excess moisture may be removed by use of a dehumidifier or an air conditioner.

SUMP PUMPS

Where gravity drainage is impossible or impracticable, or where a serious water problem arises after completion of the house, a sump pump or cellar drainer may be used to raise the water to a level where it can be carried off through a drain line.

Sump pumps are small, simple, compact units and are installed in a sump, or pit, at the low corner or other wet spot in the basement. To prevent caving in of the sides, line the sump, or pit, with a length of large draintile or with concrete or metal. Inlets, or holes, should be provided in the lining material to admit ground water. Manufacturers of sump pumps specify the size of sump, or pit, required for a particular pump.

Sump pumps are designed for automatic operation. If correctly installed and not abused, a pump requires very little attention. Dirt, lint, trash, and other waste can clog the strainer and should be kept out of the pit.

Two types of dehumidifiers are available—chemical and mechanical refrigeration. Chemical types use silica-gel or other chemical to absorb moisture from the air. The chemicals must be replaced or dried out periodically. Mechanical-refrigeration types draw the air over a refrigerated coil (called a condenser), where the moisture condenses and drains off into a drain or a collection pan.

A window-installed air conditioner will cool the basement and remove moisture at the same time. Even better is a type of air conditioner designed to dehumidify as well as to cool. It will cool to a predetermined temperature and then automatically switch over to dehumidifying until the desired setting on a humidistat is reached.

IMPROVEMENT OF OLD BASEMENTS

Waterproofing the exterior surface of existing basement walls is usually more effective than interior treatment. Waterproofing methods would be the same as for new basements (see "Wall and Floor Construction," p. 5). If outside work is done, installation of a footing drain is recommended, if one is not already installed (see "Subsurface Drainage," p. 4).

Because of the labor or cost involved, or because of the presence of trees and shrubbery, it may not be practical to dig the trench required for outside waterproofing. In such case, draintile can be laid along the inside bottom of the footings. The tile should be embedded in coarse gravel and should lead to a drainage outlet. (If a drainage outlet cannot be provided, use of a sump pump and pit should be considered.) A drain installed inside the footings is not as effective as one installed outside, but it should eliminate water pressure.

A variety of commercial compounds are available for waterproofing or dampproofing both the exterior and the interior of existing basement walls. They vary in effectiveness. Manufacturers' directions should be followed in applying them.

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