exposed and all wiring connections are concealed.

The main service entrance of wires and load center in most homes is in the utility area of the home nearest the point of entry of the electric service. Never locate these in a cabinet or closet where they are not readily visible or accessible.

Most homes today require a capacity of between 100 and 200 amperes.

When much of the heavy electrical load is some distance from the main service center, a subcenter is extended with a second distribution panel in order to shorten the length of the circuit conductors.

In the choice and planning of main disconnect and load center equipment, branch circuits of 120 and 240 volts must be provided to care for the needs of installed circuits. At least two 120-volt and one 240-volt circuit spaces should be allowed for future circuits.

The cabinet door of each load center has a table of numbered circuits. Your electrician should list on this table exactly which area or individual appliance is served by each circuit.

Finally, require your electrician to have his work checked and inspected for safety. An authorized inspector can furnish you with a copy of the Certificate of Approval.

Examples of methods used to calculate required circuits, feeders, and main entrances may be found in the National Electrical Code, a copy of which may be purchased from your State fire insurance writing bureau which is most likely in your State capitol, or obtained from the National Fire Protection Association, 60 Batterymarch Street, Boston, Mass. 02110 for $3.50.

Other helpful guides may be obtained from the National Electrical Manufacturers Association, 155 E. 44th Street, New York, N.Y. 10017, or from the Residential Group, Electric Energy Association, 90 Park Avenue, New York, N.Y. 10010.

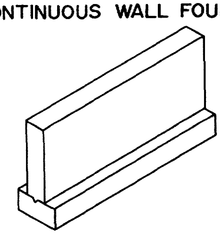
State universities and your power supplier generally have pamphets.

Foundation Facts, Basement Basics

A FOUNDATION SERVES several purposes. It supports the weight of the house and other vertical loads such as snow. It stabilizes the house against horizontal forces such as wind. It is a retaining wall which supports the earth fill around the house. And often it is a basement or cellar wall which may need to be a barrier to moisture, heat loss, or sound transmission.

The most common foundation is the continuous wall which may be built of stone, clay tile, block, brick, or concrete. Recently, treated wood, metal, and other materials have been used.

CONTINUOUS WALL FOUNDATION



Continuous walls are used to support heavy loads or to enclose a crawl space or basement. If enclosure of space is the main objective, then the wall may be built of lighter, more porous insulating materials which will reduce heat loss and sound transmission.

A step foundation is a continuous wall of variable height. It is used on steep grades or for houses with partial basements.

The pier foundation is a series of piers which support the house. They are generally masonry but sometimes

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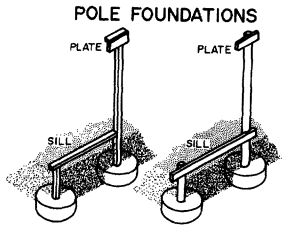
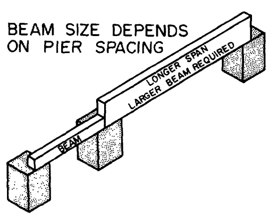
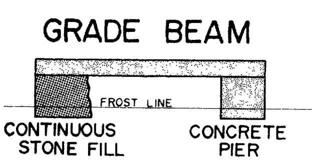


they are made of other materials. The pole or post foundation is a special kind of pier foundation built of pressure-treated wood. It is often used on steep terrain where there is considerable variation in the height of the piers and where a regular masonry pier might bend and break.

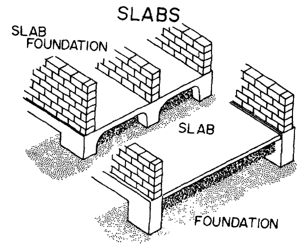
Beams placed between the piers of a pier foundation support the house.



The size of such a beam depends on the load it must carry and the distance between piers. The space between piers is generally enclosed with curtain walls which carry no load and whose main purpose is to enclose the space and act as a barrier to wind, heat, moisture, and sometimes, animals.



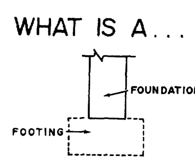
A grade beam foundation is a pressure-treated wood or reinforced concrete beam which is submerged to a depth of about 8 inches below grade. It may be supported on a stone fill or on underground piers which extend into the ground below the frost line. The grade beam is especially useful in dry climates or well drained soils where the house can be built close to the ground.



The slab foundation is a special foundation which floats on top of the soil and also serves as the floor of the house. The slab is thickened under all of the walls to support their heavy loads.

All slab floors are not slab foundations; many are simply concrete floors. A separate foundation supports the wall loads.

Every foundation must support the weight of the house and its contents. This load can vary considerably depending on the type of construction, the kind of furniture, and the special uses the house is subjected to. In colder climates, the foundation must carry the ice and snow which may accumulate on the roof. If the foundation loads are heavy, reinforced concrete will provide the strongest wall. Wider masonry walls will carry heavier loads than narrow ones.



Some houses are so heavy that the foundation must be widened at the bottom to keep them from sinking into the soil. The widened bottom on the foundation is called a footing. Its size depends on the kind of soil under it. Soil strengths vary from 1,000 to

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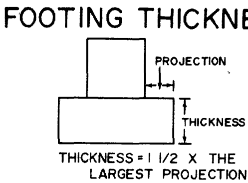
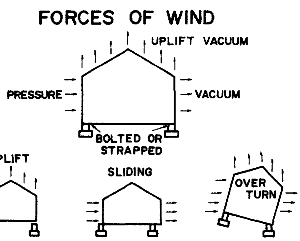
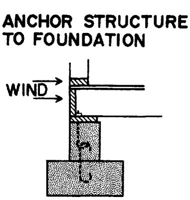
12,000 pounds per square foot. In general, footings are designed for 1,000 pounds per square foot, but if you know your soil type you may design smaller footings.



Thickness of the footing depends on how far it protrudes beyond the foundation wall. The rule is that the thickness should be 1½ times as great as the largest projection.

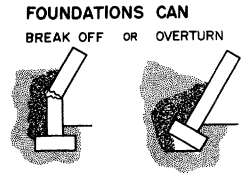


Since wind may lift or slide houses off their foundations, houses must be securely fastened to the foundation.

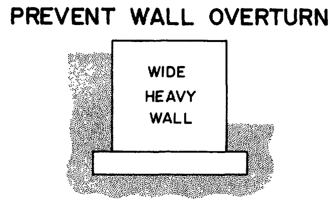


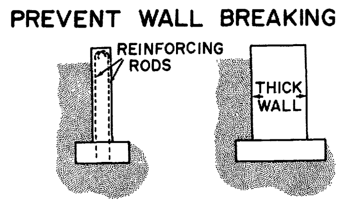
For masonry walls the fastening device should be extended through the foundation to the footing. In all cases there should be a continuous tie extending as far into the soil as practical.

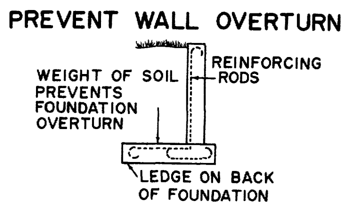
Foundations acting as retaining walls must be designed to prevent overturning or breakage. Breakage may be prevented by reinforcing or by making the wall thicker. Overturning may be prevented by making the wall thicker,

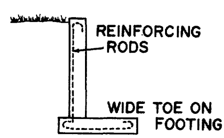


tying the wall to anchors in the soil, or counter-balancing the wall.





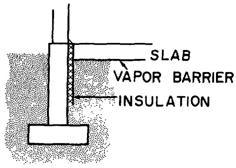


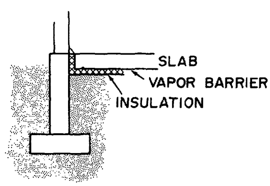


Other jobs of a foundation wall are to insulate and to moisture proof. Basements have been traditionally used as cellars to store foods and supplies, especially in the colder climates. But in recent years, with less need for long term food storage, houses are being built without basements or with basements to be used as family living areas and/or game rooms. If you are going to use your basement as a living area, you will want a dry basement which can be kept at a desired temperature.

The temperature can generally be maintained by installing a proper size heating system. But if you are going to heat economically, the foundation or basement wall must be of reasonably tight construction to prevent warm air from escaping through cracks. Most people will also want a well insulated wall to achieve maximum economy, and comfort.

SLAB FLOOR INSULATION





Since concrete is a good heat conductor, you must take special care when concrete slabs are installed close to the soil surface. A sheet of rigid insulation may be installed vertically down the inside of the foundation wall, or between the floor slab and the foundation wall and then horizontally under the slab.

Moisture in basement air is particularly troublesome in wet climates. Hot and relatively dry air from outside enters the basement where its temperature is reduced by several degrees. As air cools, it can't hold as much moisture; thus cooling the air causes it to become quite humid. If such humid air comes in contact with an even cooler surface such as the wall or the floor of the basement, it will become so humid that it will deposit some of its moisture upon the cold surface. This is called sweating.

Sweating creates an atmosphere conducive to the growth of mold and/or fungi and can be quite objectionable. This problem generally goes away in the winter months when the outside air is colder than the inside air. However, there are exceptions. One example is moisture being produced in the house by extensive boiling of water or by frequent use of hot showers. Another is moisture from the soil soaking through the basement wall and evaporating into the air.

High humidity can be dealt with. Dehumidifiers will remove several quarts of moisture per day from the air. But for dehumidification to be economical and effective, the atmosphere must be closed. Doors and windows should be kept shut. Any outside air getting into the basement will bring more moisture in and cause the dehumidifier to have that much more work to do.

Another way to deal with moisture is to eliminate cold surfaces in the basement or house. This can be done through insulation. Floors may be covered with felt paper and tile, walls may be insulated and finished.

If you insulate the wall or floor, you must provide a vapor barrier to prevent moisture in the air from flowing through the insulation to the cold surfaces where it will condense under the insulation. A plastic film, some paints, and several other materials can be vapor barriers.

One common example of moisture passing through insulation is the condensation of moisture under a carpet on a basement floor. Many people must take basement carpets up during the summer months to avoid such condensation.

In winter, ventilation can remove excess moisture from the basement or crawl space. Ventilation becomes extremely important if moisture is being produced there. But ventilation brings in cold air and exhausts warm air, so excessive ventilation will carry off a good deal of heat.

Ventilation should be used when the problem can't be handled by insulation, or when periods of high moisture production are of short duration. It is especially effective when the crawl space is not heated.

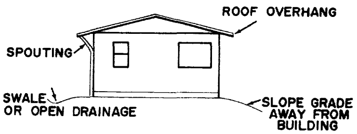
Ventilation will carry moisture being evaporated from the warm soil out of the crawl space. This keeps it from condensing on the timbers, which causes mold to grow and results in rotting of the timbers. Make sure your unheated crawl space is well vented in winter.

Heating the crawl space and insulating the foundation wall can eliminate the need for vents, and probably reduce total heat loss from the house. In this way, air from the living area can be used to ventilate the crawl space, and moisture carried out of the soil will humidify the dry air in the living area.

Another problem is moisture which flows out of the soil into the basement in liquid form either though the wall or the floor. The smart builder will give the foundation every possible advantage against ground or surface moisture by:

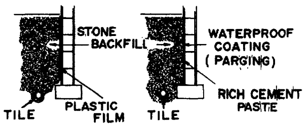
- Providing the house with gutters and down spouts to carry roof moisture away from the foundation wall.
- Sloping the grade away from the house on all sides.
- Using swales or open drainage to carry off surface water
- Back filling behind the foundation wall with porous fill, and providing drain tile at the base of the footing below the basement floor level to drain moisture away from the house.

SURFACE WATER REMOVAL



Parging (plastering) the outside of the foundation wall with a rich cement paste will prevent moisture which comes in contact with the wall from soaking into or through it. Water proof paints and coating should also be used over the parging to increase moisture resistance.

MOISTURE PROOF FOUNDATION WALL



If you have surface moisture leaking through your basement wall, the most effective solution is to dig down on the outside of the wall and install a drain field below the basement floor. Then parge and paint the wall and backfill with a coarse aggregate, such as cinders, gravel, sand, or stone. If the drain field can't be emptied by gravity, install a sump pump to carry the moisture away from the bottom of the foundation wall.

Since this solution is expensive, most homeowners will look for an alternate method.

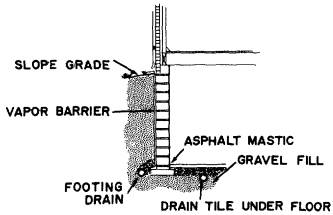
If soil moisture will flow down along the outside of the basement wall and under the house, such moisture may be removed by breaking a hole about 2 feet square and 1 to 2 feet deep in the basement floor and using a gravity drain or a sump pump to carry the moisture away.

Several patching and plastering materials have been developed for sealing cracks on the inside of basement walls. Most are ineffective. Those that are good will stop the flow in one place, but the moisture will simply back up and find a new flow path.

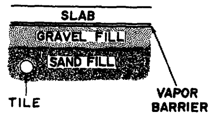
If you can be satisfied with a wet wall, some systems have been developed to keep the floor dry. They collect the water at the base of the wall and carry it to a drain or sump.

Using this same collection system, one can reduce the wall moisture by drilling a series of holes near the base of the wall just above the collection system. This causes the moisture to flow through the wall at a lower level.

MOISTURE CONTROL



MOISTURE CONTROL METHODS UNDER SLAB



Floor slabs can be protected from moisture by a gravel fill and drain tile below the floor level. A plastic vapor barrier placed over the gravel fill and under the concrete floor is another aid in keeping soil moisture from flowing through the floor into the basement.

A foundation or basement wall is often called upon to be a decorative surface, equipped with all the conveniences found in other walls.

Basement walls can be insulated and finished in several different ways. If you decide to use rigid insulation, you can attach ½ inch to 2 inches of foam plastic or other materials to the wall with a recommended adhesive. Preferably, the rigid insulation should be a vapor barrier or should have a vapor barrier attached to it. Some rigid foam panels have a plastic treated paper surface which stops water vapor.

After insulation is installed, panel board or other wall finishes can be attached to the insulation with a good grade panel adhesive. Adhesive can likewise be used to attach baseboard and moldings. Electrical outlets may be surface mounted or wires may be counter sunk into the insulation.

Another way is to use furring strips on your basement wall, and then attach a panel board to the strips.

If you are going to attach the strips to the wall with masonry nails, don't use furring thicker than ¾ inch or nominal 1 inch lumber. Thicker strips are too rigid to conform to the shape of the wall. Too often when driving the last nail you will loosen the other nails which had been securely fastened. If you want thicker furring, use two or three layers of ¾ inch strips.

With furring strips, electric wires can easily be strung from outlet to outlet and the lower cost bat type insulation may be used. A 4-mil polyethylene vapor barrier may be placed over the entire wall. The panel of wall board or other material can then be attached to the furring by conventional methods such as gluing or nailing.

If you are building or buying a house, take a little extra care and save yourself the enormous problems which are common to poorly installed basements and foundations.

When purchasing a house, check the foundation carefully. Look for sloping or unlevel floors; this can indicate the foundation has settled, timbers have rotted and/or moved, or that the floor was not level at the time of construction. You may find small cracks in most foundation walls which you can tolerate, but large cracks occur only if there is excessive foundation movement or settling.

Moisture problems are generally seasonal or intermittent. Therefore, consider the season and the current weather when examining the house. Look for moisture lines on the walls, or for dark or dry mold spots on timbers. Check timbers for soft spots, especially close to the wall and/or floor. Make sure the grade slopes away from the house and drainage is good.

When you are building, remember that if the builder follows the recommended installation procedures, chances of having a wet basement are remote. So insist on recommended installation. Find out if there are soil problems which can cause foundation headaches, and seek advice on handling such problems from your State extension engineer or other consultant.

Basements can add economy to your house. First, they are relatively low in cost. Basements are cooled by the soil in summer, thus reducing the need for air conditioning. In winter they are warmed by the soil, reducing the heat needed to keep them comfortable.

For environmental economy, solve the moisture problem, insulate adequately, and live in your basement in all weather. Keep the upstairs just for show.

Preventing Moisture Damage in Houses

HOMEOWNERS CAN USE simple procedures that control movement of water through wood construction materials to prevent moisture problems like decay, warping, paint peeling, or window condensation.

Decay is caused by small plants called fungi. Like all living things, fungi need water, almost always more than is present in the air. When wood in a house or other structure becomes damp, the ever present fungus spores come to life and use the wood as food. Drying will send the plants into dormancy until the next period of wetness. Some fungi, those causing what is erroneously termed "dry rot," are able to transport water over some distance and can work in what appears to be dry wood.

Warping, another common moisture problem, can occur because one side of a board gains or loses more moisture than the other. Since moisture causes wood cells and fibers to expand, the wettest cells and fibers expand the most and twist the board out of shape.

Moist wood is also more pliable than dry wood, and wet beams or planks supporting a weight will bend more readily. Subsequent drying will lock the wood into its warped shape.

Paint blistering may be caused by temperature changes, water, or other factors. Water in or coming through boards may collect under the relatively impervious paint layer and raise a blister. The blister may crack and cause peeling or may subside and leave a rough spot.

Many of the water sources and problems are easy to spot and correct. For example, condensation of water vapor is almost always a problem in colder climates. One of the best places to look for condensation in a house is on the windows.

Movement of water is controlled by vapor pressure, which, in turn, is controlled by temperature if all other factors are equal. Warm air can hold more moisture as vapor than can cool air. During periods of cold outdoor temperatures, the windows in a house are always colder than the air inside the house. Consequently, when the air touches the window glass, it is cooled and promptly loses some of its moisture which condenses on the glass.

Now, since all gases move from areas of high concentration to areas of low concentration, water vapor moves toward the relatively drier air near the window. It also condenses when it touches the glass and the process repeats.

The amount of condensation is determined by temperature difference and amount of water in the air. The colder the window and the wetter the air, the faster condensation proceeds.

If the air is very moist, its dewpoint, the temperature at which condensation occurs, will be higher. Hence mirrors at room temperature become clouded in a steamy bathroom.

The process of water vapor moving from warmer to colder locations can also take place in walls that allow material to move through them. Here, the movement is much slower. In the winter time the moisture moves from the warm, inner side of the wall to the cold, outer side.

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