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Please note

The trend today is to the finished basement. In more and more homes, space in the basement is being converted to recreation rooms, work-shops and offices. The results not always satisfactory if precautions have not been taken to ensure that the basement will be dry. This Digest deals with the techniques used during construction to ensure a dry basement and the proper procedure for applying an interior finish to walls and floors.

The practice of finishing basements is relatively new. Basements in older homes were often small, damp and poorly lighted, accommodating the heating plant and fuel and providing good storage conditions for fruits and vegetables. The basement was not considered acceptable as a play area for children or as a storage space for unwanted or unused items of furniture, clothing and toys. More recently, with the popularity in Canada of the one-story bungalow, basements are large and well lighted but not always dry. Many of these basements are being finished in a variety of ways to provide additional living space. Regardless of how the basement is finished, however, it is essential that the basement be dry if it is to serve as useful space.

Waterproofing the Basement

The method used to waterproof a basement will depend on the groundwater level, the type of soil and the drainage of the building lot. The most severe conditions will occur in low lying areas where at times the groundwater level is near the surface of the ground. If in such a location the soil is coarse grained, then a basement should not exist. Water will pass so freely through such soil that it will be impossible to lower the water table adjacent to, the basement walls. If the soil is fine grained it will restrict the movement of water and a dry basement may be constructed, provided the water table is lowered by means of drain tile located at the footings to intercept water and carry it away from the site.

Drain tile must be laid so that they are entirely below the level of the basement floor; the usual practice is to lay the tile on undisturbed soil at the level of the bottom of the footing. Tile are laid with a $^{3}/8$-in. gap, the top half of which is covered with a saturated felt to prevent ingress of fine particles of soil.

Methods have been developed by which the walls and floors of a basement can be waterproofed to resist the hydrostatic pressure of several feet of water. This is done by applying a continuous membrane consisting of alternate layers of bituminous materials and felt to concrete that has been properly mixed, placed and cured. It is risky to adopt this procedure for light structures in an attempt to overcome the problem of poorly drained sites. The lifting pressure of this water amounts to 311 341 tons per 1000 sq. ft of floor area per foot of water. Such a pressure will cause structural failure of the floor unless it has been designed to resist the force: this can only be done at considerable expense. If the floor is constructed to resist the upward force, then there is a possibility that the house itself could be lifted out of the ground. The use of a membrane to keep a basement dry under wet site conditions is not sufficient by itself; steps must also be taken by the provision of adequate drainage to prevent the build-up of water pressure under floors and against walls.

Good practice in basement construction requires footing tile to carry subsurface water from the site, granular fill under the floor slab and over the tile and a bituminous coating on the exterior of the basement walls. Since the purpose of the granular fill is to permit drainage of water to the tile drains and to prevent movement of moisture by capillarity from the soil to the concrete, the gravel or crushed stone must be kept clean. The bituminous coating should be applied directly to concrete walls and over a continuous ½-in. cement plaster coat in the case of masonry walls. To ensure drainage from under the floor, tiles or pipes should be placed through the footing to permit drainage to the footing tile.

It is also considered good practice to apply 4-mil polyethylene or heavy roll roofing over the granular fill before the concrete floor slab is placed. This not only acts as a vapour barrier, virtually ensuring a dry floor, but prevents concrete from penetrating the granular fill. Should this occur, capillary paths are provided enabling moisture to move from the ground to the floor slab. If the floor is to be laid to a definite elevation, the amount of concrete that can be saved by the use of the plastic film amounts to 1 or 2 yards for a 30 by 40-ft slab. To avoid punctures, the plastic film should be placed on a layer of bituminous felt.

If walls or floors of basements in houses already built show signs of dampness or seepage, action must be taken to correct these faults before the surfaces are covered. Dampness on a basement wall can be controlled by applying two coats of a water-cement paint. These paints consist of ordinary or white portland cement and water and may include sand. The paint is mixed to a pancake batter consistency and scrubbed into the wall with a stiff brush. Water-cement paint, to be effective and durable, must be cured in the same way that concrete is cured. Water-cement paints unlike most other types of paint, may be applied to a damp surface; in fact, a dry concrete surface must be dampened before application of the paint.

Seepage through a basement wall indicates that the footing drain is plugged or that something is preventing surface water reaching the tile. If the seepage is not extensive, the wall may be waterproofed by applying a cement plaster to the inside surface. Since it is very difficult to plaster a wall while water is seeping through it, repairs should be carried out during a dry period. The plaster should be at least 3/8-in. thick. Extensive seepage or leaks can be corrected only by excavating to the footings, installing or repairing drain tile and replacing the bituminous damp-proof coating on the exterior of the basement walls.

Leakage through the basement floor indicates the presence of water under pressure. If there is a granular porous layer under the slab, this pressure can be relieved by connecting the space under the slab to the footing tile by a tile or pipe placed under the footing. If the slab is placed directly on a heavy clay soil a second footing drain must be installed under the floor next to the footings or in the area of most leakage. A connection must be made to a sump pit or to the exterior footing tile.

Application of Interior Finish to Basement

There are many ways in which to finish the inside of a basement wall. One method is to apply a coating of paint directly to the concrete or masonry surface. This is a simple and economical method since inexpensive water-cement paints can be used. No moisture problem results but there is, of course, no insulation value in the paint film. In most cases, walls are finished with materials such as plywood, wood fiber board or gypsum board applied to furring strips. Insulation is often added to decrease the heat loss. Finishes of this kind, which cover up the concrete, introduce rather complex problems particularly in regard to moisture control.

Unlike other walls of the house, the requirements of a basement waIl vary from top to bottom. The portion of the wall above grade must meet the same requirements as any exterior wall exposed to the weather. The portion of the basement wall below grade is, however, subjected to very different conditions and the design of the wall must be changed.

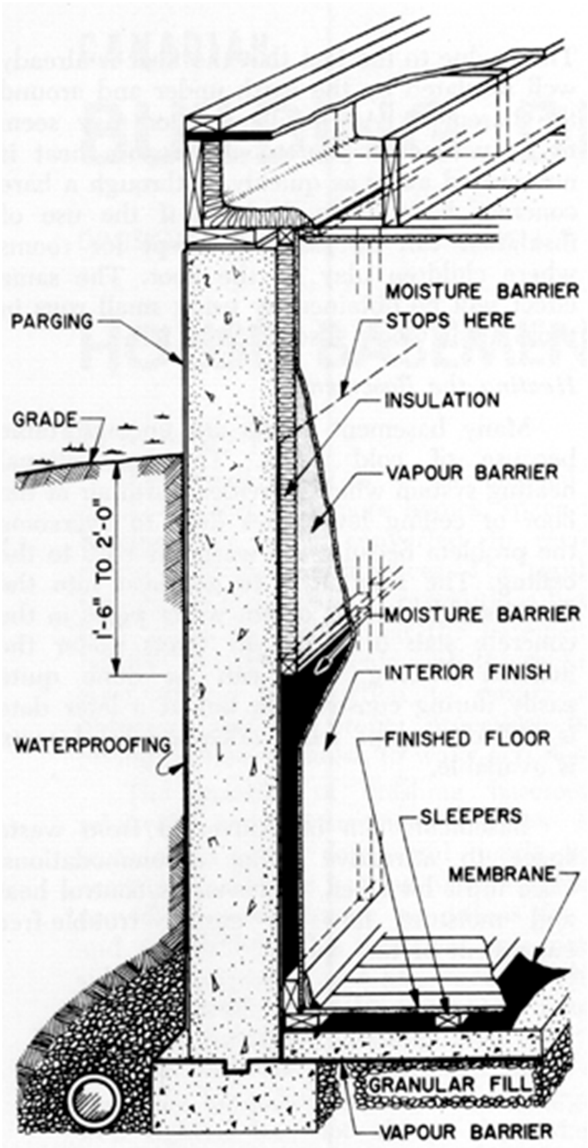
In the lower part of the wall moisture that may come from damp earth must be considered. Where the interior surface of the wall is not covered, any moisture that may pass through the wall is free to evaporate to the air in the basement. The appearance of white crystals resembling a fungus growth shows that moisture is moving through the wall and evaporating from the surface. This process may proceed, however, leaving no trace of its presence. If a finish is applied over the surface of the wall below grade then moisture, if present, cannot readily evaporate and the wall may become damp. Under these conditions, only the most durable of building materials can be expected to last.

The first step, therefore, in finishing the wall is to provide a moisture barrier that extends from grade level down to the floor. An asphalt emulsion or cutback asphalt may be used to provide a continuous membrane. (Tar should not be used since the odour is often objectionable.) Sheet material such as 2-mil polyethylene provides a good moisture barrier. It can be held in place with cold asphalt mastic or by the furring strips which will support the interior finish. Vertical or horizontal strips may be used depending on the type of interior finish that is selected.

Insulation of a basement wall should be considered even when no further improvement of the basement is contemplated. The heat loss through the upper portion of an uninsulated wall is six or seven times that of the average well-insulated wall. Thus the cost of insulating will be recovered in fuel saving within a few years. Insulation is applied to, the upper part of the wall only, that is, from the ceiling down to, a point 1½ to 2 ft below grade. Below this level, the earth against the outside of the wall provides the insulation that is necessary.

A vapour barrier should also be applied to the upper portion of the Wall. Where the upper portion is insulated, the vapour barrier backing on batt-type insulation is sufficient. Even when no insulation is used, a vapour barrier should be applied to prevent water vapour passing into the wall and condensing on the cold concrete.

Where vertical furring strips are used, it is advisable to fasten a horizontal strip to the wall at a point 1½ to 2 ft below grade. This will provide backing for the bottom of the vapour barrier and will block off the air space of uninsulated walls. The interior finish may then be attached to the furring strips.



Application of Finishes to Basement Floors

As in the case with basement walls, many types of finishes are suitable for basement floors. A good concrete floor surface may be left as it is or it may be waxed or painted. Most basement floors, however, have many surface cracks and are subject to dusting. The minimum treatment in such cases is an application of a surface hardener such as sodium silicate or the fluosilicates (zinc or magnesium) followed by a concrete floor paint. Rubber-base concrete floor paints have given good service on below-grade basement floors.

Asphalt, asphalt asbestos and vinyl asbestos floor tile are the types most commonly used on below-grade basement floors. These are fastened to the concrete by an asphalt mastic which is resistant to attack by alkali moisture. Recently new epoxy adhesives have been developed which permit the use of vinyl and rubber tile on concrete floors below grade. Linoleum and cork tile are still not recommended, however, for concrete floors below grade.

Wood floors may be used below grade but only after suitable preparation of the concrete slab. A moisture barrier under the slab should be installed during construction when it is known that a wood floor is to be used. If an existing floor has no record of dampness, it should also be suitable. In either case, a membrane should be applied to the concrete slab before the sleepers are put in place. The floor is first primed with asphalt primer, after which an asphalt mastic is applied. A membrane consisting of 2 layers of 15-lb asphalt saturated felt or 1 ply of 2-mil polyethylene is then laid in the mastic. An additional layer of mastic is laid over the membrane and the sleepers embedded in this mastic. The mastic used must be either a cold-applied emulsion or cut-back when polyethylene is used as a membrane. Where asphalt felt is used either cold-applied or hot-applied mastic may be used.

Sleepers consist of straight, flat, seasoned 2 x 3's or 2 x 4's 24 in. to 36 in. long, impregnated with wood preservative. They are spaced at 16-in. centres where a subfloor is used or at 12-in. centres where the finished floor is applied directly to the sleepers. A space is left at the edge of the floor to allow for any movement of the finished floor.

Insulation of a basement floor is often considered as a means of making a recreation room more comfortable. The addition of insulation will not, however, raise the floor surface temperature to any significant extent.

This is due to the fact that the floor is already well insulated by the earth under and around the basement. An insulated floor may seem to be warmer to the touch because heat is not carried away as quickly as through a bare concrete floor. It is doubtful if the use of insulation can be justified except for rooms where children play on the floor. The same effect will be obtained by using small rugs in those areas where discomfort is felt.

Heating the Basement

Many basement rooms are uncomfortable because of cold floors. The conventional heating system which provides warm air at the floor or ceiling level does little to overcome the problem because the warm air rises to the ceiling. The solution is to get heat into the floor itself by means of hot water pipes in the concrete slab or warm air ducts under the finished flooring. This can be done quite easily during construction but at a later date is difficult except when adequate head room is available.

Basements can be converted from waste space to attractive living accommodations. Care must be taken, however, to control heat and moisture flow to ensure trouble-free enjoyment of this space.

Addition to Canadian Building Digest No. 13 (added Feb. 1974)

CBD 13 considers only solid concrete walls in the discussion on insulation. Owing to the complications that may arise because of convection in the air space in the hollow cores of concrete blocks, it is recommended that concrete block walls be insulated over the full height of the wall. A vapour barrier should be used to cover all the insulation.

With either solid concrete or block walls, it is essential that the insulation be installed so that no air space remains between the insulation and the concrete wall surface. If such an air space exists, air circulation may reduce the effectiveness of the insulation and condensation may occur on the concrete wall surfaces.