# BUILDING NOTE





## THE CONTROL OF MOISTURE IN BASEMENTS

by

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For many years basement and cellar space was used mainly for the storage of fuel, bulk and preserved foods, and general storage so that the presence of limited amounts of moisture created no special problems. More recent trends in the use of this space for sleeping, for recreation, and for laundries and other work areas have emphasized the need for improved control over moisture in the space. Improvement of this space through finishing has brought to light the fact that relatively small amounts of moisture can be a problem. Floor finishes may not stay in place, mildew may develop, and equipment may rust. In most cases, the control of moisture subsequent to construction is a costly procedure. It is therefore important that consideration be given to the control of moisture in house basements from the start of construction.

The degree of protection necessary in a particular area may be difficult to estimate. In areas where rainfall is generally high, complete protection must be attempted. In areas where high rainfall is exceptional, is is reasonable to provide less complete protection, particularly if the basement space is to receive only limited use as living space. It is suggested, however, that the variations in rainfall that occur throughout Canada indicate a high order of protection in all cases where the basement space is to be developed completely as living space.

## SOURCES OF MOISTURE IN BASEMENTS

Moisture appears in a basement from movement of water through the foundation walls or from condensation of water vapour from the air in the basement space. Control of the movement of water through the foundation walls is certainly the principal problem since, even if it is relatively small in volume, it will increase the possibility of condensation. Condensation is more apt to be a problem in areas where the relative humidity of the air in summer is high. For this reason ventilation of basements on hot, humid days should be avoided.

## MOVEMENT OF MOISTURE THROUGH FOUNDATION WALLS

Moisture passes through foundation walls in several ways. Under pressure, it can move through cracks or holes in and around foundation walls and floors. It can also move through foundation walls and floors as a result of capillary forces in the masonry materials. Water may also move as vapour under certain conditions. The amount of water passing through a wall, due to capillarity, will depend on the nature of the masonry material itself and on the amount of evaporation that can take place from the inside surface of the foundation wall or basement floor. In many cases, capillary movement

of water is not noticed because it is removed by evaporation as quickly as it appears on the wall or floor surface. The application of a paint film or a flooring material, which prevents evaporation, may allow a build-up of moisture behind the finish and this often causes its subsequent failure.

Asphaltic and other chemical compounds are sometimes used as "integral waterproofers" in concretes and cement plasters. These materials will, to a varying degree, reduce the capillary movement of water through masonry. Thus, they may serve in a limited way as long as evaporation can take place on the inside. The action of these materials is not completely understood, as yet, and there is evidence that they may increase the permeability of materials to water under pressure. This class of materials should not be regarded as a major waterproofing element.

## METHODS OF CONTROLLING MOISTURE IN BASEMENTS

### Drainage

The first means of protecting a basement should be an attempt to keep water away from the foundation walls. Thus, drainage is perhaps the most important protection that can be provided.

### Surface Drains

Wherever possible ground should be sloped away from the building, to control surface run-off, and to prevent water from standing near or against the foundation walls. On sloping sites it may be necessary to construct a cut-off drain on the high side, to lead surface water around the building to a lower level.

Roof run-off should be collected and diverted away from the basement by means of surface drains.

### Subsurface Drains

The provision of drains around the perimeter of the footings for foundation walls is recommended for any site where the groundwater table is likely to be above the top of the footing. These drains should be placed beside the footing, not on, or at the level of the top of the footing, and they should be slightly graded to an outlet. The outlet may be to lower ground on sloping sites, to a sewer, or to a sump within the basement. When drains empty into a sewer, it is necessary to plan carefully so that a slope

can be maintained throughout the system. Water in sumps can be pumped, preferably by automatic pumps, to ground surface or sewer for disposal.

In porous soils, such as sands and gravels, footing drains may actually assist in lowering the groundwater table in the vicinity of the basement. In clay soils the movement of water is generally very slow and the drains are not likely to act in this way. In spite of this, footing drains can be effective in protecting a basement in clay soils. During periods of little rainfall and sometimes in winter, clay soils will tend to shrink away from a basement wall. This shrinkage opens a channel for water to come in contact with the wall in the spring or after rains. Footing drains will provide a means of removing this water quickly.

On sites having fine-grained soils the use of a porous backfill over the footing drains and next to the basement wall is likely to provide additional assurance of rapid drainage, so that wet earth does not come in contact with the foundation wall. This porous backfill can be placed almost to ground level. It can then be covered with a layer of clay to limit the entry of surface water to the porous material below.

If adequate surface and footing drains are provided, it is probably not necessary to provide special drainage under basement floors. A layer of uniformly sized granular material about 5 or 6 inches thick should be placed as a base for the basement floor. This layer is intended to act as a capillary break to prevent the rise of moisture from wet soil below into the concrete floor. If over-watered concrete is placed over this base the concrete will flow into the base and, in many cases, the effectiveness of the base as a capillary break is lost. The use of a membrane over the base to keep the concrete floor separated from the granular base is recommended. The only requirement for this membrane is that it be tough enough not to puncture during the placing of the concrete.

A greater degree of protection can be provided for floors by the inclusion of a waterproof membrane in the basement floor. It is necessary where a moisture sensitive flooring, such as linoleum or cork, is to be used. The membrane can be provided by placing a thin layer of concrete to meet the level of the top of the footing. This first lift should be screeded to a smooth surface and allowed to set. Mopped or sprayed layers of bituminous material can then be placed. Each layer of bituminous material may be followed with saturated felt or open-weave material if desired, to reinforce the bituminous material. The bituminous material should be continued up the foundation wall to the finished floor level. The basement floor slab can be placed over the membrane, once it has set. Heavy roll roofing and polyethylene film with joints sealed with asphaltic material would serve as alternative membrane applications.

## BITUMINOUS COATINGS FOR THE CONTROL OF MOISTURE IN BASEMENTS

The procedures so far described have been directed toward the prevention of moisture contact with foundation walls. One further step, that of providing a coating of bituminous material on the outside of the foundation walls, is recommended in all cases.

For most soil moisture conditions where adequate drainage is provided it will be necessary only to spray or brush a continuous coating of asphalt or coal-tar pitch on the foundation wall. The walls should be brushed to remove dirt and loose material. Oil or grease on foundation walls should be removed as it will prevent the proper adhesion of the bituminous coatings. Then the bituminous coatings can be applied. Two applications should be made. The bitumen should be continued over the top of the footing to direct water into the footing drains. Each coat should be allowed to set before a following coat is applied and the final coat should be firm before backfilling is done.

The brush or spray application of relatively thin coatings of bituminous materials on basement walls is commonly described as damp proofing. This type of application can be improved by the introduction of reinforcing membranes between applications of bituminous material. Improved resistance to the movement of water is provided and additional protection against leaks through cracks in foundation walls should result. This type of application is commonly known as water proofing. The membrane applied to walls should be made continuous with the membrane installed in the basement floor which has been described. This type of application is likely to be too costly for the average house but it is definitely recommended where underground drainage is not possible.

## THE DETECTION OF SOURCES OF MOISTURE IN BASEMENTS

The control of a moisture problem in an existing basement often will be difficult, and in some cases it may be costly. The first problem is to determine the source of the moisture and it may be equally difficult to determine the path of the moisture flow.

Leakage of water under pressure is generally simple to detect as water will appear at cracks, at the junction between the floor and the wall, or over an area where the concrete is honeycombed. If the flow of water is sufficient to run down the wall or across the floor it will be necessary either to plug the leak or to install drainage to reduce the water pressure and remove the water. Cracks or junctions should be cut back an inch or more in depth and at least an inch on each side of the crack to allow for the placing of crack filler. The enlarged crack should taper to the wall surface to prevent the filler from being pushed out of the crack. A crack filler may be prepared from a quick-setting

cement and sand. Rapid-setting commercial crack fillers which expand on setting are available for this purpose. If the flow of water is strong it will be necessary to support the crack filler until it has gained sufficient strength. Honeycombed areas on concrete walls may be parged with cement plaster to reduce the flow of water. Where the flow of water through a wall is not strong, parging with cement plaster or applications of water cement paints may reduce the flow of water to an acceptable amount.

Where leakage occurs through cracks in and around floors the provision of a sump below the floor may remove the water pressure from the floor. Where granular fill has been provided under the floor, water will drain through this to the sump. If there is no granular base under the floor it may be necessary to install drains under the basement floor in combination with a sump. If possible automatic discharge pumps should be installed in sumps to remove water to a sewer or to the ground surface outside.

The transfer of moisture by capillary action may result in a high humidity condition in a basement, or the accumulation of moisture, or efflorescent salts behind surface finishes applied to walls or floors. To determine if water is moving by capillary action, place a rubber mat on a floor for a period of several days. If moisture collects under the mat this indicates that water is saturating the concrete under the mat. The presence of salt deposits on floors or walls may indicate slow seepage or capillary movement of water. There is no simple method of preventing capillary moisture movement if it exists, short of a major effort to reduce the moisture content of the soil adjacent to the wall or floor. Deep drainage might be effective in granular soils, but would probably be ineffective in clay soils. The condensation of moisture in basements may result from a high humidity condition caused by the evaporation, in the basement, of water passing through walls and floors by capillary action, or it may result from high outside humidity. It can be detected by water drops forming on cold water pipes or by placing a sheet of glass or metal on the floor or wall. If water accumulates on the surface of the glass or metal, after the surface has had time to come to the same temperature as the surface in question, it is an indication of excessive humidity in the basement. Condensation can be controlled by ventilation with drier outside air, or by the use of an electrical dehumidifier. Certain salts will absorb moisture from the air and, if exposed in a basement, may be effective in reducing humidity. Special containers to permit contact of the air with the salt should be used. Corrosion of metal containers by wet salt may also be a problem.

It will be apparent that it is very difficult to remedy a wet basement condition except by the provision of adequate drainage combined with damp-proofing, or by a complete waterproofing operation. Although some methods have been suggested to assist in the control of the problem, no assurance can be given that acceptable protection will result. The best that can be expected is that the movement of water can be reduced to an amount that will not create a hazard to health or the structure.