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EBS Notes on the Science of Building NSB 52

Dampness in buildings

Dampness tends to be gauged by its effects. Many building materials normally contain in service large quantities of water in relation to their weight, but they are regarded as dry. Yet if their water content is so increased as to cause the flaking or peeling of paint, the crazing of plaster, the decay of timber, or the growth of mould, they are considered to be damp.

CAUSES OF DAMPNESS

1.01. It is important that the cause of dampness in a building be established before attempts are made to remedy the matter. Some common causes of dampness in buildings are:

- water remaining from the construction of the building;
- rain penetration;
- dampness rising from the ground;
- condensation of moisture;
- presence of hygroscopic salts;
- defects in plumbing or drainage.

These causes, and remedial measures where possible, are discussed in this Note.

WATER REMAINING FROM CONSTRUCTION

2.01. Considerable quantities of water are introduced into traditional buildings during construction by the concreting, bricklaying, plastering and tiling trades. Furthermore, additional moisture is absorbed by the work if it is exposed to rain before the building is roofed.

2.02. Buildings are often occupied before they have dried out and in the process of drying out defects occur—mainly in finishes—that are not the results of faults in the materials themselves. It is only when the evidence of dampness persists for a long time after the building has been completed that an intensive investigation is justified.

2.03. When moisture evaporates from building materials it frequently leaves surface patches of crystalline deposit or a powdery bloom of water-soluble salts. These deposits are referred to as efflorescence. They are conspicuous when they appear on brickwork, but they are less obvious on plastered surfaces.

2.04. Deposits of salts can be destructive to finishes and may be responsible for subsequent recurring dampness. The latter point is discussed in paragraphs 8.01 to 8.03.

2.05. Most of the evaporation of the moisture from a building material will occur by the easiest path, so that if a damp wall has an impervious finish on one side only, most of the water will evaporate from the opposite side. Thus the effects of dampness may be visible on that side only, while the other may remain unmarked.

RAIN PENETRATION THROUGH ROOFS, CHIMNEYS AND PARAPETS

3.01. **Roofs.** Rain is likely to penetrate roofs that are pitched too low, or where there is insufficient side or end laps for the particular roof cladding. This is especially the case on long roof slopes, which can be flooded at their lower ends during heavy downpours of rain to a depth sufficient to cause water to penetrate under the end and side laps of the roof cladding. In addition, rain may be blown back along the underside of the end of the roof sheeting into the interior of the building. One method of preventing this is to place a barrier of foamed plastic strip, moulded to the profile of the roof sheeting, on the last batten or purlin supporting the roofing material.

3.02. Failure of roof claddings and flashings is often responsible for dampness indoors. In pitched roofs, these faults can usually be easily traced and treated, but in flat roofs it is generally difficult to establish the point of failure as any water that penetrates the roof may travel some distance laterally before becoming obvious.

3.03. Sarking with waterproof sheeting is the usual method of coping with rain penetration when the roof pitch is low. The sarking is commonly placed under the roof cladding, either above or below the rafters, but when the leakage of water is small it may be expedient simply to lay a protective membrane over the ceiling joists so as to collect the water, which will evaporate later.

3.04. **Parapets and chimneys.** Incorrect detailing of parapets and chimneys is a common source of trouble. The omission or the blockage of weep-holes above chimney trays is sometimes responsible for the overflowing of the trays, with consequent dampness at or adjacent to chimney breasts.

3.05. Deterioration or destruction of flashings and damp-proof courses is not unusual in parapets and chimneys. A type of failure often encountered in the flashing of parapets is fatigue cracking of lead brought about by bending or by temperature changes in the exposed material. Temperature changes cause continual expansion and contraction, particularly of that part of the lead not built into the wall and cracks occur at the junction of the free and restrained portions of the material. The effect can be reduced by the use of heavy-gauge lead, antimonial lead, or a silver-copper-lead alloy, but it is preferable to use copper instead of lead.

RAIN PENETRATION THROUGH SOLID BRICK WALLS

4.01. Water penetrates solid brick walls, notably under conditions of strong wind and rain, via the mortar joints and fine capillary cracks that normally occur in walls. Instances have been noted where water has been seen running freely down the inside face of a solid wall.

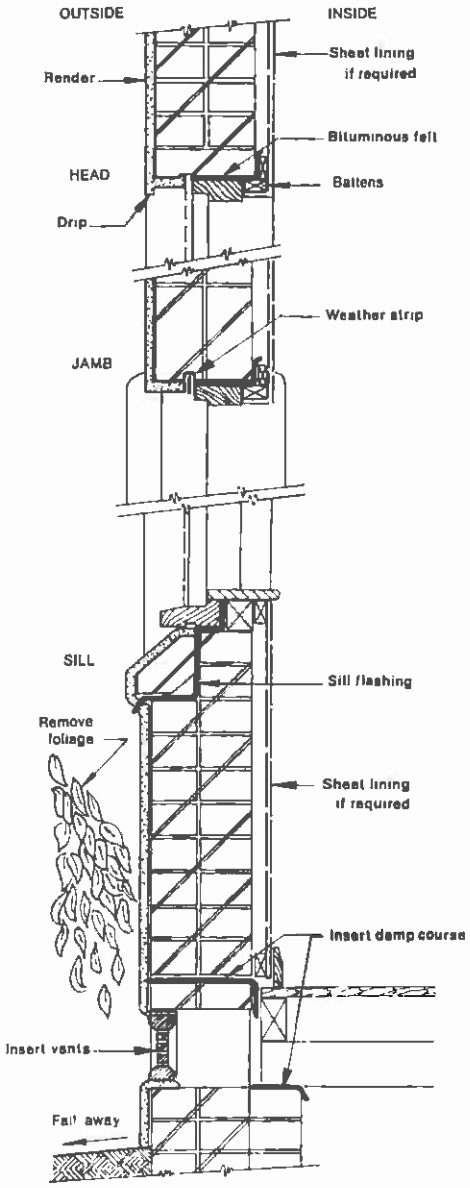
4.02. **Rendering.** Solid brick walls can be made more weathertight by rendering the outside surface. A porous, absorbent rendering is recommended rather than a dense, impervious one that might trap water behind it. It is suggested that a mix of 1 : 1 : 6 or 1 : 2 : 9 of cement : lime : sand by volume be adopted, rather than the commonly used 1 : 3, cement : sand mortar. Dense cement renderings are more prone to cracking, and water running down the face of the wall may thereby be driven by wind into the brickwork. Water so trapped is prevented by impervious rendering from readily migrating outwards and so it may move towards the inner face, causing dampness, and possibly efflorescence.

4.03. Rough-textured surfaces, such as rough-cast, are less likely to permit rain penetration than smooth surfaces, as rough finishes are less liable to crack. Furthermore, they tend to shed much of the water that falls on them, and they also provide a greater area from which the water can evaporate.

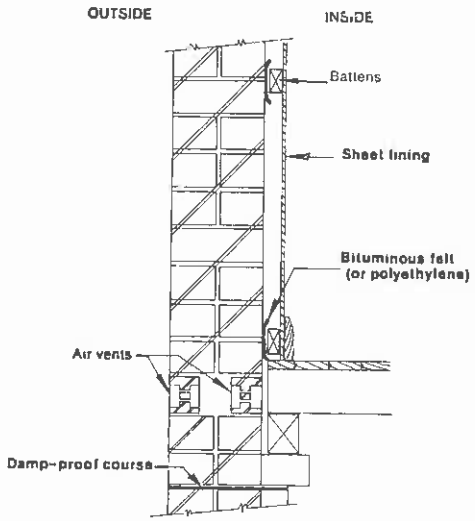
4.04. **Painting.** Painting the exterior surface with several coats of an impervious paint, or the application to it of a silicone formulation to aid water shedding, is sometimes adequate. Both types of material require periodic renewal, however, in order to remain effective.

4.05. **Battening-out.** A method used in England to overcome the problem of damp internal walls resulting from rain penetration through the wall or from rising damp is to fasten battens to the damp wall and to cover them with sheet material such as fibrous plaster, hardboard, plywood, or asbestos cement.

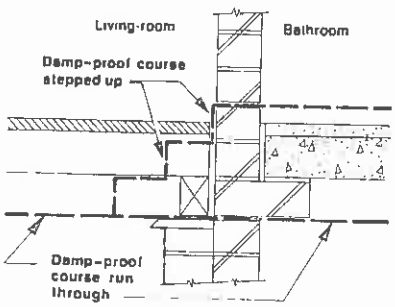
4.06. Both plugs and battens should be of durable timbers, preferably impregnated with a suitable odourless preservative, and the battens should be placed on a strip of damp-proof material such as polyethylene or bituminous felt. It is also an advantage if the inner face of the wall is painted with an impervious paint, such as a bituminous emulsion, before the battens are applied. It is advisable to ventilate the space behind the lining wherever it is possible to do so.



Damp-proofing of existing solid walls



Battening walls



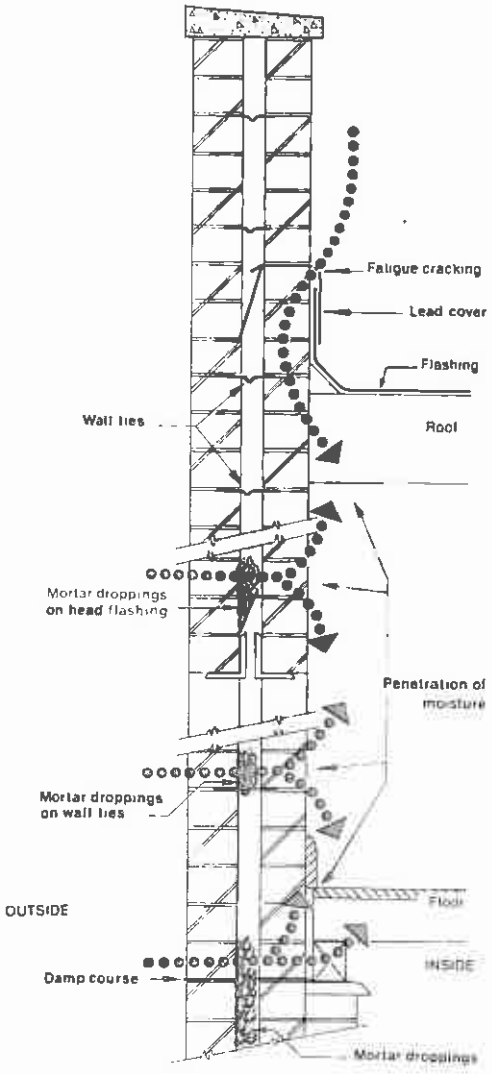
Damp-proofing bathroom floors

RAIN PENETRATION THROUGH CAVITY WALLS

5.01. Cavity walls are recognised as being the most satisfactory form of brick construction to prevent rain penetration, but even these can prove troublesome on occasion. The most common failures are caused by mortar droppings on the wall ties or by the bridging of a cavity by brickbats, faulty installation of flashings at openings, failure to carry the cavity below the damp-proof course, and an accumulation of mortar droppings in the bottom of the cavity.

5.02. **Bridging of cavity.** Dampness caused by mortar droppings on wall ties or by brickbats is characterised by the appearance of damp patches on the wall after rain. These patches are usually unrelated to building elements such as doors, windows, or chimneys.

5.03. Mortar droppings on ties, or brickbats bridging the cavity, can be dislodged by means of a chain or long batten if the top of the cavity is accessible. Alternatively, bricks may be taken out opposite the offending damp patch and the obstruction removed.



Damp penetration in cavity walls

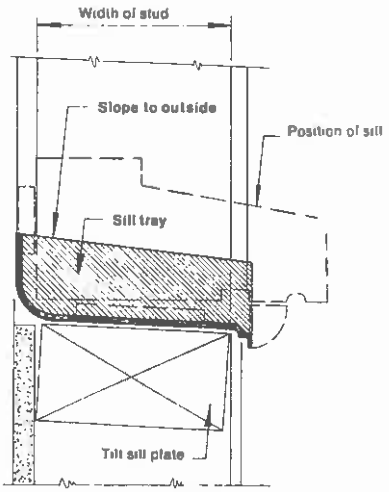
5.04. **Blocking of cavity.** The cavity should extend not less than two brick courses below the damp-proof course, and should be cleaned out as late as practicable during the erection of the building.

5.05. Mortar droppings in the bottom of the cavity can build up sufficiently to rise above the damp-proof course and thus lead water to bypass it. Cleaning out the bottom of the cavity is effective in such instances.

5.06. **Flashing defects.** Dampness resulting from leakage around an opening is usually recognisable by its proximity to the opening after rain. Faulty installation of flashings is usually responsible.

5.07. A common point of failure is at the end of a sill, where the sill tray may be dressed hard against the frame. This permits the water that sometimes runs down the side of the window-frame to run across to the inside sheeting instead of being collected by the tray and turned outwards. Another defect often encountered in timber-frame buildings is the bedding-down of the sill on the sill tray, resulting in the formation of a capillary path along which water may travel.

5.08. Failure to provide side-flashings to openings in walls exposed to extreme conditions of wind and rain may be responsible for considerable internal dampness. Sometimes, too, flashings over the heads of openings are blocked with mortar droppings which transmit water from the outer to the inner faces of the walls.



Sill tray

RISING DAMPNESS

6.01. Dampness in buildings that is caused by moisture rising from the ground is one of the most difficult forms of dampness to counter. It is usually symptomatic of major trouble, such as the breakdown and consequent failure of the damp-proof course, or the lack of a damp-proof course in the construction. Dampness of this form is characterised by its persistence at or near floor level.

6.02. **Failure of the damp-proof course.** Certain materials used for horizontal damp-proof courses may be subject to corrosive and other destructive actions when built into brick walls. When breakdown occurs, the damp-proof courses are eventually destroyed, perforated, or cracked, and are thus rendered ineffective.

6.03. **Lack of a damp-proof course.** Many old buildings that are still sound have been built without damp-proof courses. The most effective way of coping with dampness in this situation is to insert a damp-proof course — an expensive and difficult operation — and in the case of old buildings with thick, solid walls of rubble, one that is practically impossible to perform. Therefore, it is probably best to try other means before attempts are made to insert a damp-proof course. For example, the amount of water in and about the walls might be reduced with the aid of agricultural drains, concrete or bituminous paths around the building, or improved underfloor ventilation, or a combination of two or more of these. It may be advisable, also, to remove foliage growing against external walls, and to check the functioning of existing drains. Consideration might be given also to 'battening-out' as described in paragraphs 4.05 and 4.06.

6.04. **Inserting a damp-proof course.** A damp-proof course can be satisfactorily inserted in an existing wall only if the mortar is sufficiently soft to be cut out with a saw. The common practice is to saw out the horizontal joint for a distance of about 1 m, and to place a strip of stiff, heavy, damp-proof-course material, such as 2·5 mm lead, in the aperture thus formed. The strip is then wedged in position, and the joint packed with a rather dry cement mortar. This process is repeated until the entire defective area has been treated. The strips of damp-proof-course material should have a lap of about 100 mm. Another method is to remove two or three bricks and insert in the space thus left a roll of damp-proof-course material which is then unrolled as bricks are in turn removed, re-inserted, and then re-bedded.

6.05. Cases of minor dampness resulting from rising damp in external walls have been remedied by covering the internal surfaces of the walls with a dense cement rendering. The rendering has the effect of forcing most of the moisture to evaporate at the external face. It has been suggested that any such repair should be carried out at least 1 m above the highest point at which dampness is visible.

CONDENSATION OF MOISTURE

7.01. Condensation of water vapour on cold surfaces leads to dampness which can be troublesome. It commonly occurs in kitchens, bathrooms, and laundries, where copious quantities of water vapour are released into the enclosed space.

7.02. Condensation is not always visible; it can occur on absorbent surfaces, leading to their deterioration, or it can occur within timber-frame walling or on the underside of timber floors, and affect the construction. Condensation problems are discussed in detail in NSB Nos. 32, 61, and 78. Where such dampness is unavoidable it is desirable to employ materials and finishes largely unaffected by intermittent wetting, and preservative treatments where timber is involved.

7.03. Room heating and natural ventilation serve to inhibit condensation.

HYGROSCOPIC SALTS

8.01. During periods of high humidity, which may not necessarily be associated with rain, the appearance of damp patches can usually be attributed to the presence of salts that readily absorb moisture from the atmosphere. Such salts are usually water-soluble, and may be derived from mortar, from bricks, or from the ground in circumstances where the damp-proof course has failed.

8.02. Such dampness commonly conveys salts in building materials to the surface, where they may crystallise or form a powdery bloom (efflorescence) as described in paragraphs 2.03 and 2.04. Although the salts may be present initially only in relatively small proportions, their subsequent migration will cause them to build up into surface patches of increasing area.

8.03. Dampness associated with hygroscopic salts will recur in humid weather even after the original water has dried out or the rising damp has been remedied. In bad cases (after the original cause of the dampness has disappeared or been dealt with) it may be necessary to remove the internal plastering from the affected areas, and to replaster them. Where the quantity of salts is small, the defect may possibly be dealt with by heavily and repeatedly brushing off the efflorescence, and then applying a sealer and redecorating. This remedy is not always effective, but it can be tried before more drastic measures are employed.

DEFECTS IN PLUMBING OR DRAINAGE

9.01. The effects of leaks from plumbing and drainage systems will sometimes give the appearance of dampness from rain penetration, but faulty plumbing can usually be recognised by the location of affected areas in relation to piping, and because of their occurrence during periods of dry weather.

CONCLUSION

10.01. Lack of proper identification of the cause of dampness in buildings may lead to the adoption of inappropriate measures that may aggravate the problem for which a solution is sought. Proper identification is simplified if the following information is available:

(a) the location, extent, and pattern of the affected area, in relation to external openings, parapets, roof valleys, plumbing services, and the like. Original plans and details might assist here.
(b) the time of occurrence of dampness in relation to rainfall or periods of high humidity.
(c) the history of previous attempts (if any) to cure the trouble.

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'Some Condensation Problems'. *Notes on the Science of Building No. 78.* Commonwealth Experimental Building Station, Sydney, 1964.

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