The Need for Old Buildings to 'Breathe'

SPAB Technical Advice Note

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In order to repair a building one needs to be able to understand the building's construction and the causes of its decay. From the mid-19th century, rapid changes in construction methods occurred and a number of new building materials were introduced. Many of these materials are perfectly suitable for contemporary buildings, but have been found to be incompatible with the construction of old buildings. The aim of this Technical Advice Note is to examine these differences and draw conclusions about the way old buildings should be treated.

Cover image:
The walling materials and finishes on old buildings were generally absorbent so allowed the fabric to 'breathe'.
Photo: Matthew Slocombe

1 Introduction

Modern buildings tend to rely on an impervious outer layer or a system of barriers to prevent moisture penetrating the walls, whereas buildings constructed before the mid-19th century generally rely on allowing the moisture which has been absorbed by the fabric to evaporate from the surface (see figure 1). The thickness of the wall alone in these earlier buildings may have been relied upon to achieve acceptably dry conditions internally.

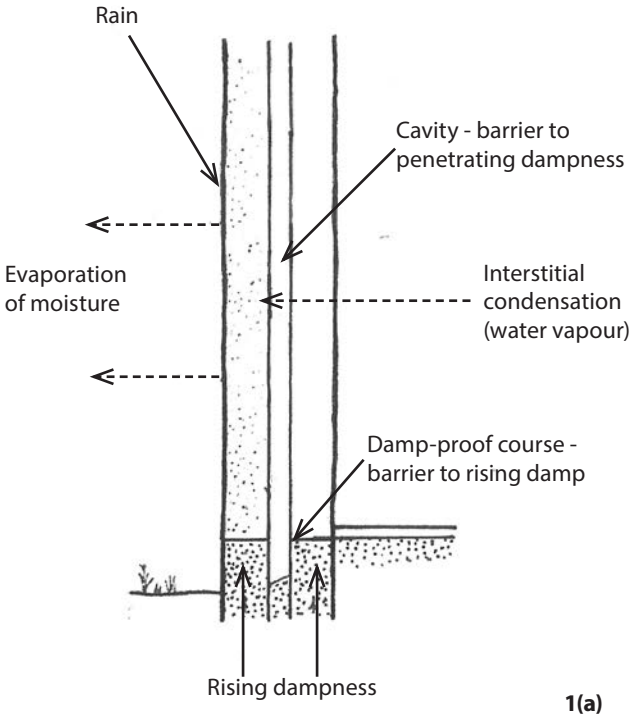
The walling materials of old buildings in Britain are usually stone, brick, timber and earth (cob, wattle and daub), which are all absorbent. Mortars used to construct walls of brick and stone were usually of lime and sand, but earth or earth/lime mortars were sometimes used. The porous nature of these mortars permits evaporation of moisture from within the wall. As the mortars are usually more permeable than the materials they bond, walls are often dependent upon the evaporation of moisture from the joints to remain acceptably dry.

External rendering was usually lime-based, and therefore absorbent. Where this was used to improve the weather-resistance of the wall, it is common to find that this render has a rough open-textured surface, which tends to maximise the surface area and thus the amount of moisture able to evaporate is increased.

Buildings used to be decorated, internally and externally, almost exclusively with limewash, which could be coloured with natural pigments. Limewash is again, a porous material and allows the wall to 'breathe'.

The concept behind the construction of old buildings is that moisture entering the wall should be able to evaporate. Whereas modern buildings rely on keeping water out by a system of barriers.

Technical terms used in this guidance are defined in our online glossary.[1]



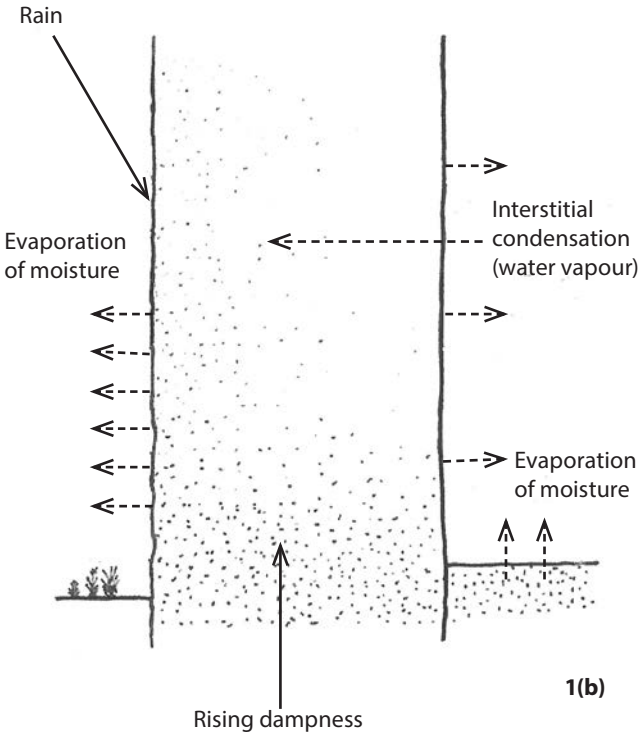


Figure 1: Understanding the behaviour of old walls: **(a)** Basic modern cavity wall. **(b)** Solid wall of porous materials.
Illustrations: Philip Hughes

2 Problems caused by the use of impervious materials

2.1 Different building types

In a modern building, the damage or failure of one of its moisture barriers will lead to severe problems of dampness penetration. In an old building, anything that prevents the evaporation of moisture from walls will lead to similar difficulties. Hence the two building types need to be handled in completely different ways: modern buildings will be damp without a barrier to moisture, because the economy of design does not provide a massive and absorbent structure, but old buildings will become damp if an impervious layer is applied to them, because this prevents water within the structure from evaporating.

As the moisture content of the wall increases, the likelihood of decay also increases. Timbers may succumb to wet or dry rot attack because their moisture content is too high. Timbers often occur in solid masonry walls in the form of lintels, spreaders for beam or joist ends, as bonding timbers or as fixing blocks. In masonry walls, the mortar will also be susceptible to decay if excessive moisture levels persist. This is particularly so of the lime/earth mortars used in vernacular buildings. Cob (a mixture of natural soil, straw and cow dung, compacted in layers to form walls) will decay extremely rapidly if it becomes wet and unable to dry out (see figure 2).

2.2 Paint systems

Paint systems for exterior use tend to prevent evaporation of moisture from the surface. They are designed to prevent the ingress of moisture, but when used on the solid walls of old buildings, water inevitably gets behind the paint film in time (see figure 3). Unable to evaporate from the surface, this moisture is trapped and unless it is able to evaporate from the inner face of the wall the moisture content of the wall will gradually increase. In hot weather, moisture behind the paint film will vaporise, causing blistering, and in cold weather the wall surface may be damaged by frost action (see figure 4).

As the surface layer of paint begins to break down, further water penetration will occur leading to increased dampness.

2.3 External renders

Strong cement renders have a very similar effect to impervious paint films, but renders are even more susceptible to cracking and subsequent breakdown (see figure 5). The resulting decay is often more dramatic. Strong cement renders tend to form hair cracks as they set: these are hardly visible to the eye, but moisture enters the wall by capillary action. Once in the wall, this water is trapped, because evaporation is

Figure 2: Water penetration has resulted in the decay of these cob walls. The cement render applied externally prevented them from drying out and led to the suddenness of the collapse. Photo: Chris Shapland

Figure 3: Frequently overflowing hopper head and gutter have saturated the wall behind an impervious paint layer. Decay of the walling immediately behind the paint film has resulted in flaking. Photo: Philip Hughes

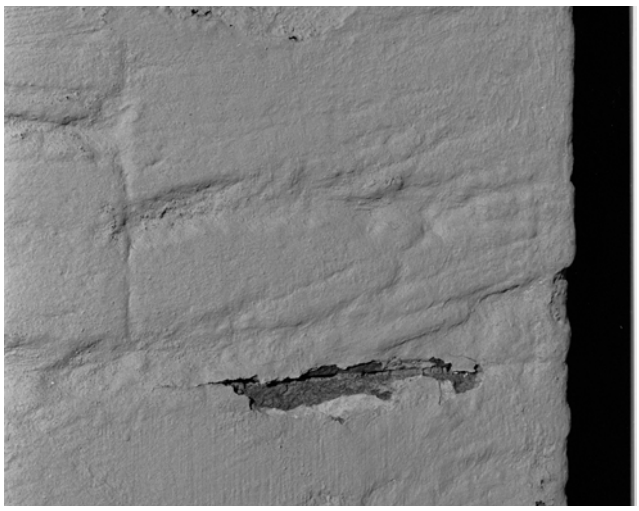


Figure 4: Moisture trapped behind an impervious paint film has caused it to blister. The effect of salts and frost has led to further decay. Photo: Philip Hughes

Figure 5: Strong cement render on a cob wall. The render is being forced off the wall and is taking the surface of the cob with it. The cob behind this is decaying. Photo: Philip Hughes

Figure 6: Dense cement pointing splurged over the face of the stonework inhibits the evaporation of water from the wall and leads to rapid decay of the stone. Photo: Philip Hughes

prevented by the impermeability of the render. Where the render has been applied over soft brick or stone, severe breakdown of the weak underlying material can occur.

2.4 Pointing

External cement-rich pointing of an old wall has slightly different implications (see figures 6 to 9). Once again, water will get into the wall through the masonry or through cracks in the pointing, and due to the impermeability of the mortar will be unable to evaporate from the joints, as originally intended. Moisture within the wall will, therefore, have to evaporate from the surface of the masonry rather than from the pointing, leading to increased decay of the masonry due to the deposition of salts or frost action at its surface.

It is preferable that a soft lime mortar with rough texture and lower strength than surrounding masonry be used for pointing and bedding. This encourages moisture to evaporate through the joints, rather than through the masonry units. Deposition of most of the salts will therefore occur at these mortar joints and the mortar will decay more rapidly than the masonry. Thus the pointing may be regarded as sacrificial. It is also, of course, cheaper and easier to repoint at intervals than to replace bricks or blocks of stone. This also helps to maximise retention of historic fabric.

2.5 Internal plaster

If the wall has been left with original lime plaster, then water unable to evaporate from the exterior will evaporate from the interior, with consequent disturbance to finishes. Furthermore, increased moisture content leads to decreased thermal insulation of a wall. Evaporation of moisture has a cooling effect on the surroundings and excessive levels of dampness will represent a considerable heat loss.

Figure 7: Strong cement-based mortar survives while the wall it was used to point up decays. This could have been avoided by the use of a lime-based mortar, weaker than the brickwork. Photo: Philip Hughes

Figure 8: This wall has been repointed in a cement-based mortar. It is suffering severely from the deposition of salts. Efflorescence is occurring on the surface of the bricks instead of on the mortar joints as would be the case had a porous lime mortar been used. Photo: Philip Hughes

If dense plasters are used internally, moisture will again be prevented from evaporating and the level of dampness in the wall will increase. A gradual increase in salt concentrations within the wall and the deposition of crystals below the surface will tend to blow the plaster off the wall, or lead to expansion of the plaster layer itself and consequent bulging.

Where dense plasters are used to cover a wall suffering from rising dampness, the effect may be only to drive the moisture higher up the wall (see figure 10). This may cause old plaster which had remained sound hitherto to become affected, or may force moisture up the wall and into contact with timber, making it susceptible to decay.

2.6 Modern extensions

All the factors must be considered carefully when repairing, altering or extending an old building. Extensions cause particular difficulties because the materials in use for the new extension will often be quite unsuitable for works to the fabric of the old building, and yet it is common for work to be carried out on new and old at the same time. It is important to take great care to ensure that damaging work is not executed. Where a full specification has been prepared, it may be necessary to include two sets of workmanship and materials clauses: one set for the new extension and one for work to the existing building.

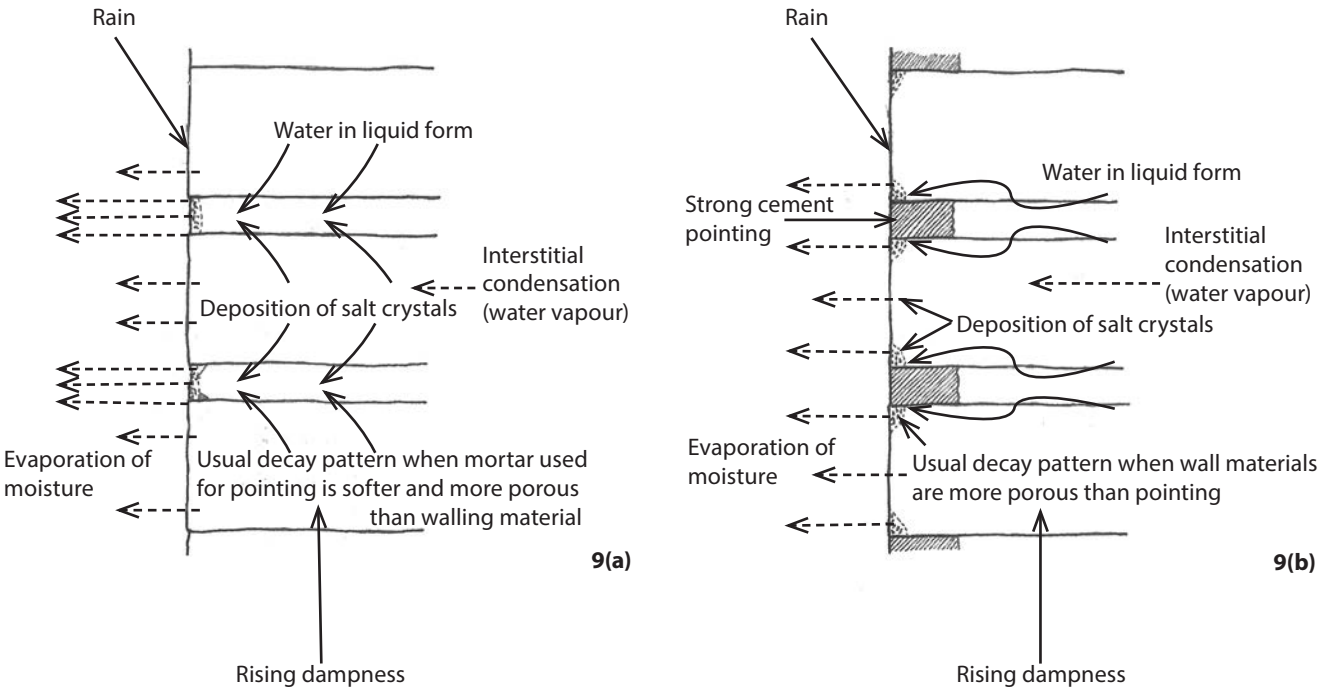


Figure 9: Movement of moisture: **(a)** Wall built of porous materials. **(b)** Effect of imperious pointing.

Illustrations: Philip Hughes

Figure 10: Strong cement-based render has been used to replace plaster affected by dampness on the lower part of these massive walls. As a result the dampness has risen higher in the wall and has now affected the old plaster that had remained sound. Photo: Philip Hughes

Figure 11: Salt crystallisation behind the strong cement patches on this plinth has led to both these being forced off and to further disintegration of the stonework. Photo: Philip Hughes

Figure 12: Strong cement pointing being forced off the wall by crystallisation of salts behind. Increased levels of dampness within the wall have caused decay of the earth-lime mortar, leading to compaction of the wall – also forcing off the dense pointing. Photo: Philip Hughes

Figure 13: Cement render has been applied over a lime roughcast on this timber-framed building. The cement is being carefully removed in small pieces by forming hairline cracks with a lump hammer. Photo: Philip Hughes

3 The correct treatment of old buildings

Under normal circumstances, older buildings will function well if they are allowed to work as they were intended to do. Mortars, plasters, renders and finishes should all be of relatively permeable materials, allowing moisture to pass through them and evaporate from the surface.[2] Traditionally mortars, plasters and renders were usually lime-based, and decoration was with limewash.

In the case of an old building which has already been treated in some way with an impervious material, watch the building carefully for any signs of the problems mentioned in this Advice Note, and at the first sign of these occurring take remedial action if possible (see figures 11 and 12).

Remedial action should ideally involve the removal of any impervious materials and their replacement with permeable ones. This is not always possible without doing further damage to the fabric of the building and compromise may be necessary.

Cement renders can sometimes be removed after working over the surface thoroughly with a hammer to fracture the render into small units (see figure 13). Levering off large sheets of render will cause severe damage to soft underlying materials. Where a render is so hard that it does not respond, it is probably best to leave it to age naturally. Rendering should be in a lime mix.[3]

Cement pointing should be cut out but sometimes it adheres so well that its removal will damage the surrounding masonry. In these circumstances it is usually best to leave what cannot be removed easily and to patch point with a lime-based mortar.[4]

Paints can sometimes be scraped off when they have started to blister and peel or may be removed by any of the methods suggested in the SPAB Information Sheet on *Removing Paint from Old Buildings*. Paints which adhere strongly and which resist the usual removal methods are best left until they age. If, in the latter case, they should become patchy, the wall can be redecorated in limewash until the paint is sufficiently decayed to remove.

Where walls have been mistreated in any of the ways mentioned, it is essential they are kept as dry and as well ventilated as possible. Water must not be allowed to enter the top of the wall or behind the impervious material.

Solid walls which have become saturated may take many months or even years to dry out. During the drying process, salts will be deposited on the surfaces, and this can lead to severe breakdown of the materials. In some cases it may be necessary to poultice the wall or apply another finish over it to draw the salts out of the masonry. This is particularly important where ornamental work may be at risk.

If in any doubt, seek professional advice from an architect or building surveyor experienced in the repair of historic buildings. The SPAB can usually suggest names of people with experience in this field.

4 References

1 See https://www.spab.org.uk/advice/glossary

2 for more about permeability, see SPAB statement on Breathability and Old Buildings

3 Further advice on lime renders is given in English Heritage, 2011

4 For more about repointing, see SPAB Technical Pamphlet 5 on *Repointing Stone and Brick Walling*

5 Other advice

5.1 Contacts

Where work to old buildings is being considered, the SPAB may be able to suggest suitable specialists, including contractors.

5.2 Further reading

English Heritage (2011) *Mortars, Renders and Plasters,* Practical Building Conservation, Farnham: Ashgate Publishing Ltd

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Warning

The term 'breathing' is often applied to many products which are only slightly vapour permeable. In general, no synthetic modern materials should be applied to the masonry or plaster surfaces of historic buildings. If in any doubt, contact the SPAB.

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