
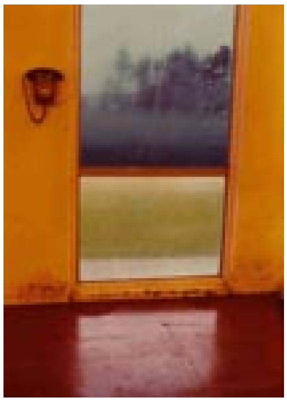
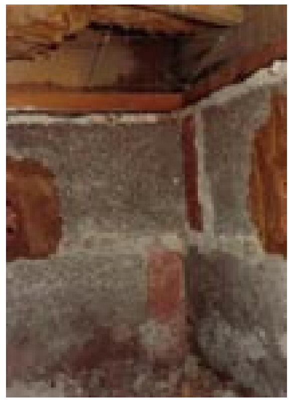


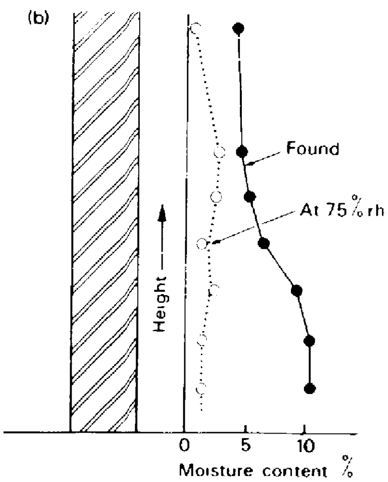

Understanding dampness

Peter Trotman
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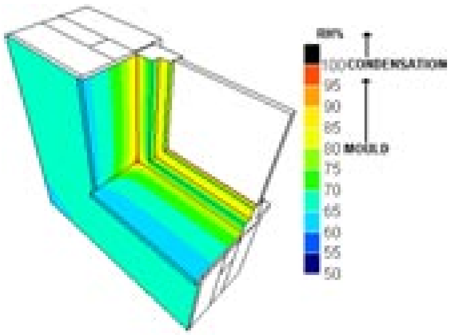

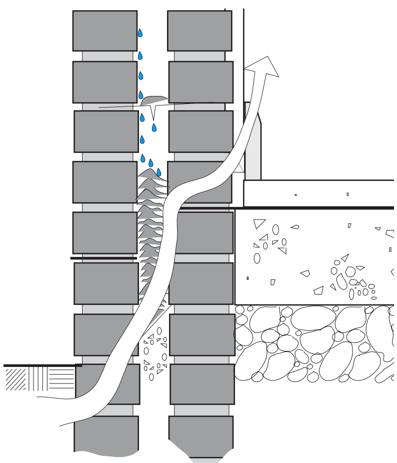

Understanding dampness

Effects, causes, diagnosis and remedies

Peter Trotman, Chris Sanders and Harry Harrison

BRE

constructing the future

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Preface

Many years ago, before the Building Research Station was founded, the British Medical Association asked the Royal Institute of British Architects to investigate the causes of dampness in dwelling houses to help them find the reasons for the prevalence of certain diseases. The RIBA committee found that direct penetration of rain through walls and lack of a damp-proof course (DPC) accounted for nearly two-thirds of all cases; condensation contributed only 2%. The causes may have since changed in relative importance with changes in construction techniques, such as cavity walls and the tendency for houses to be better heated. Unfortunately, though, dampness is a continuing source of distress to occupants. It is possibly a source or a contributor to illness, it encourages deterioration in the building fabric, and it is involved in half of the investigations undertaken over the years by BRE.

As well as damp patches on walls, ceilings and floors, dampness can lead to blistering paint, bulging plaster, rot in building timbers, mould on surfaces and fabrics, and sulfate attack on brickwork. It can also lead to less visible problems, such as reduced effectiveness of thermal insulation or cracking in brickwork as a result of corrosion of embedded metal components. Despite all the technical advice that has been published in the past, there is still a significant set of problems. This book seeks to address them.

Readership

This book is aimed primarily at all professionals involved in the design, maintenance and management of domestic, public, commercial and industrial properties; this includes surveyors, architects, builders and facilities managers. It will also be useful to student members of these professions. Much of the text and many of the illustrations will also be of relevance to householders and other users of buildings.

Scope of the book

The emphasis of this book is on existing buildings with some coverage of the design of new build. It lists the causes of dampness in buildings and explores the consequential effects of that dampness on the fabric, the maintenance of protection against dampness, and the remedies which the detrimental results of dampness will call for.

It is illustrated with photographs of defects from the BRE Advisory Service collection and drawings of construction elements that need careful design and execution. Case studies illustrate some of the more typical problems which have been investigated as well as some interesting but informative non-typical cases, although it must be recognised that it is rare to find two cases which are identical in every detail.

Chapter 1 contains background information. Chapter 2 provides a visual indication of the most common manifestations of dampness to be seen in buildings, tabulated according to building element. When the appearance of the defect under investigation has been matched with the appropriate photograph, a key provides a link to later chapters which give explanations of the physics, further information to confirm the diagnosis, and the remedies which might be specified to put right the defect.

Although this book is mainly about existing buildings, and not specifically about the design of new buildings, it gives some design criteria so that subsequent performance of the completed building may be assessed against what was either required or intended.

Some important definitions

Condensation: the process whereby water is deposited from air containing water vapour when its temperature drops to or below the dewpoint.

Dampness: used here to cover a wide variety of phenomena relating to the unwanted presence of water or water vapour, whatever its cause.

Deliquescent substance: substance which becomes damp and finally liquifies on exposure to the atmosphere, owing to the low vapour pressure of its saturated solution.

Dewpoint temperature of the air: the temperature at which condensation of liquid water starts when air is cooled, at constant vapour pressure.

Hygroscopic substance: usually applied to solids which tend to absorb moisture from the atmosphere without actually becoming liquified.

Psychrometric: Relating to the measurement of water vapour in the air, including the use of the wet and dry bulb hygrometer.

Rain penetration of walls and roofs: results from water entering the structure to such an extent that the resulting dampness or dripping of water becomes a nuisance.

Relative humidity: the ratio, normally expressed as a percentage, of the actual amount of water vapour present to the amount that would be present if the air were saturated at the same temperature.

Reverse condensation (*old term: summer condensation*): interstitial condensation that can occur when moisture within a wall is driven in by solar radiation on south-facing walls.

Rising damp: normally the upward transfer of moisture in a porous material due to capillary action.

Thermal bridge (*old term: cold bridge*): part of a structure of lower thermal resistance which bridges adjacent parts of higher thermal resistance and which can result in localised cold surfaces on which condensation, mould growth and/or pattern staining can occur.

Vapour control layer (VCL): usually a thin sheet material with a vapour resistance greater than 200 MNs/g, used on the warm side of thermal insulation to restrict moisture which diffuses through the insulation from condensing on any colder outer surface.

Acknowledgements

Unless otherwise attributed, photographs have been provided from our own collections or from the BRE Photographic Archive, a unique collection dating from the early 1920s.

We offer our thanks to the following colleagues and former colleagues who have suggested material for this book or commented on drafts, or both:
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Chapter 5
Rain penetration

This chapter tells you how to assess the risk of specific designs in actual locations in the UK using the driving rain index, and deals with rain penetration in solid and cavity masonry walls, cavity wall insulation, cladding systems, DPC detailing principles and well-tried details, rain penetration of pitched and flat roofs, parapets and leaking windows.

Figure 5.1 A disfiguring deposit of carbonate from rain penetrating the sloping brickwork parapet

Figure 5.2 Although much of this results from condensation, there is also some rain penetration

There are regional construction differences throughout the UK as a result of local experience and practice as well as available materials. In more exposed locations, walls may be sand:cement rendered and slate or tile-hung in Cornwall and Scotland. Pitched roofs are given a second line of defence with a sarking material of felt or plastics. In Scotland, boarding is used as the sarking. Windows in Scotland are usually inset to give protection; other parts of the UK use a narrow sill with the window much closer to the line of the outer leaf.

DRIVING RAIN

In the Building Regulations, control of moisture is a functional requirement and the building must be designed to adequately resist such penetration – see Approved Document Part C and Part G.

An International Council for Research and Innovation in Building and Construction (CIB) *Working Commission on Rain Penetration* meeting in the 1950s adopted a definition of rain penetration:
By rain penetration is meant that rainwater penetrates into a wall either through the surface of the wall, or due to leakage at windows or similar installations. It is not necessary that water penetrates so far that it may be discernible on the inside of the wall. More information is in *Rain Penetration Investigations - A summary of the findings of CIB Working Commission on Rain Penetration - Oslo 1963*.

Rain penetration in modern cavity walls tends to show as a well-defined roughly circular area on internal finishes. Sometimes surface salts will define the outer limits of such wetting. If the wetting persists, most of the wall may become visibly damp. In older, solid wall buildings, wetting may not be visible because successive coats of emulsion paint or vinyl wallpaper have masked the effects. The extent of the dampness, or if dry the salts which define it, can be traced with a moisture meter.

Figure 5.3 Severe wetting from driving rain on an exposed wall

Moisture can be deposited on external surfaces in several ways:
- ❐ Gentle rain or drizzle normally falls vertically and will accumulate on flat surfaces. Some splashing may wet adjacent surfaces.
- ❐ Driving rain, which is heavy rain blown by a strong wind on to horizontal and vertical surfaces. Water can also be blown uphill on sloping surfaces.
- ❐ Snowfall and wind-blown snowdrifts have little effect at the time but when the snow melts, it can cause severe wetting, particularly very fine snow blown into pitched roofs.
- ❐ Fog wets external surfaces but in small quantities and has little effect.
- ❐ Condensation can occur on outside surfaces in tropical climates, particularly with air-conditioned buildings. Storms in these climates are more likely to be a test of weathertightness.