Foreword

This series of booklets has been produced by the Department of the Environment to increase awareness of the value of our architectural heritage and to provide information on the basic principles and methods of conservation and restoration. The titles in the series are listed on the back of each booklet.

These texts are not intended to be comprehensive technical or legal guides. The main aim is to assist architects, builders, owners and others,in understanding the guiding principles of conservation and restoration. They will facilitate the identification of the most common problems encountered in heritage buildings,and indicate the best solutions. It should be appreciated that specialised aspects of conservation and restoration will require professional expertise and more detailed information.

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Summary of Conservation Principles

- Research prior to planning work
- Minimum intervention - repair rather than replace
- Respect the setting.

Summary of Conservation Procedure

- Research and analyse history of building
- Survey building and identify original material
- Plan work according to conservation principles
- Use experts where necessary
- Record all work
- Install maintenance procedures.

Introduction

The sources of water ingress relate primarily to rainfall,humidity and groundwater. Climatic conditions play a major role, particularly the levels of exposure of buildings and their location near the sea or in a marine environment. The influence of moisture on building materials relates to their porosity and ability to absorb water. All traditional building materials have levels of porosity varying from low porosity to highly porous brick,timber and plaster.

Brief History

In 18th century building construction, attempts were made to reduce moisture movement by the construction of areas to the front of buildings. In the 1870s building byelaws required the installation of damp proof courses and in many instances these damp proof courses in building construction consisted of courses of slates. This form of damp proof coursing is inadequate and is unlikely to stop the movement of ground water upwards.

Common Problems and Solutions

1. Lack of damp proof course

Historic buildings constructed on stone or brick rising walls have no damp proof course or membrane. Groundwater penetrating the rising walls moves upwards carrying with it various salts. The upward movement of this water can lead to saturation and results in damage to timber, plaster etc. The water is absorbed easily through porous brick and bedding mortar. Ground salts are often hygroscopic. The level of moisture within a wall is determined by its ability to evaporate moisture. If the evaporating conditions are altered or reduced through rendering the wall surface with plaster or dense repointing, the level of moisture within the wall is likely to rise. The effect of groundwater on timber in constant saturation appears to be minimal. There are a variety of approaches to inserting damp proof membranes or courses.

Cutting out

The most radical approach - rarely used - involves the cutting or disking through the full wall thickness and the installation of a d.p.c. in lead. This approach,whilst likely to lead to the highest levels of success,is only possible in brick walling or coursed stone. The disadvantages are that it may result in settlement and that it is an extremely expensive method of overcoming the problems of rising damp.

Osmotic system

This system has received considerable attention in recent times. The electro osmotic system can either be active or passive. In the active system an electrical charge is passed through the wall which creates the 'helholtz effect',driving moisture downward. The Building Research Establishment (U.K.) has investigated electro osmotic damp proofing and it has some reservations about its effectiveness particularly in relation to the passive system. It recommends that the electrodes should be of carbon or platinised titanium to avoid rusting and failure within the wall. The system may offer a level of protection and is considerably cheaper and less intrusive than other systems of damp proof coursing.

Porous knapten tubes

This system of damp proofing is not used very often. It involves the installation of a porous tube in the outer wall at low level. The idea behind it is that through the evaporation process created by the porous tube the wall will dry out by evaporating moisture to the tube. This system has some limited level of success. It is likely to be shortlived where groundwater contains hygroscopic salt and where the salt forms on the tube and in the surrounding areas. The formation of the salt is likely to attract external sources of moisture thus reducing the effectiveness of the system.

Injection and infusion

The most common systems of damp proof coursing involve the installation of a chemical damp proof course. These chemicals include a range of siloxanes;aluminium sterate and potassium methyl silocanate. The efficiency of chemical injection systems depends on the efficiency of the fluid penetration of a damp structure. High pressure injection systems are not likely to lead to the greatest levels of success as the effect created in the wall by high pressure is likely to result in the movement following the routes of least resistance and in creating a condition known as viscous fingering within the wall.

The longer injection time involved with low pressure systems increases the level of infusion. It should be borne in mind that the success of chemical injection may also be affected by seasonal factors. Where water tables and saturation levels are high the level of success of the injection is likely to be reduced. It is important in the installation of a chemical injection/infusion system that the drill hole spacings,their depth and the quantity of fluid injected per meter run meet with the manufacturer's requirements.

External masonry treatments

In many instances where water penetration through walls is taking place the application of external masonry treatments is considered as a remedy. It is well known that water penetration occurs mainly at the interface cracks between mortar and brick or stone. Tests for leakage have proved that 90% of the air passes through these cracks.

Water leakage is likely to follow the same route. This point demonstrates that driven rain water is more likely to pass through a wall constructed in a material with a low porosity than it will do through a wall constructed in highly porous brick or stone which has the ability to absorb and hold the water. The role required of any external masonry treatments in this situation is to cover or fill cracks if it is to be efficient. Even the most successful treatments are unable to fulfil this role. A water repellent cannot act and should ideally not be a water proofer but should improve the wall's water repellency. It is also important to note that some surface treatment may 'case harden' the outer layers of brick or stone and cause spalling and loss of surface material.

Replastering

Specialist damp proofing firms recommend surface treatment and replastering on internal walls using dense mixes combined with water proofing agents. These can be effective. However, a weaker and more vapour permeable mix would be appropriate. The use of a softer mortar is likely to create a more intimate bond with the walls and reduce on boasting and separation.

Repointing

As a method of reducing moisture, repointing of walls is often considered. Unless the pointing has severely deteriorated repointing may be unnecessary and alternative action should be considered. It should be noted that overdense repointing may only serve to aggravate a dampness problem by trapping water, reducing evaporation and thus forcing the water to evaporate through the wall material instead of through the more easily replaced mortar.

Drylining

As an alternative to replastering,systems of drylining may be considered. Historically, drylining systems,such as the use of wainscotting, were used to mask areas of chronic water ingress. The installation of drylining systems on non-perishable grounds may serve to mask, but do not solve, a problem which is beyond any other form of remedial action. Methods of drylining must be carefully considered for use on old buildings as they may intrude on historic detail.

TIMBER DECAY

Introduction

Most heritage buildings contain timber elements, ranging from the structural roof timbers and bonding timbers in walls to floor joists and lintels. These can all be vulnerable to decay. Timber decay takes many forms, the most significant being fungi and wood boring beetles.

Decayed bonding timbers can be replaced easily by brickwork or concrete.

Fungal Attack

Fungi differ in the moisture content they require in timber but a moisture content below 20% should provide an immunity. Dry rot and wet rot are from the same group of fungi,which include the common mushroom and toadstool. Dry rot is always associated with water ingress and with timber associated with damp masonry. Wet rot or cell fungus is usually found in areas where timbers are saturated below ground level. Dry rot may develop where conditions are drier. Dry rot attack is a most serious problem in historic buildings. The discovery of dry rot is likely to cause alarm. *It is important in investigating an outbreak to first determine its level of activity.*

Common Problems

1. Dry rot and wet rot

The dry rot may be dead or dormant or live. In opening up historic buildings,pockets of dry rot are often encountered. Dead dry rot is of no consequence unless it is affecting structural stability in timbers. Black dormant or dead dry rot leaves a residue of patches. The affected wood shrinks and cubes and becomes dry. Timber in this condition may not require treatment but it is important that it is carefully inspected as spores can germinate for a number of years. Fresh or active dry rot fruit is usually a rust brown with a white margin and a cratered surface for spore production. On the surface of the fruit there may be droplets of water. If portions of the fungus are removed and heated in the hand fresh fungus will give an aroma of mushrooms. This smell is often clearly present in buildings under attack.

In recent years,significant research has been carried out by scientists and mycologists into the mechanisms of dry rot. A scientific understanding of the problems associated with dry rot has changed the approach to treatment and has challenged the effectiveness and success,in particular, with saturation/irrigation. Practitioners have been led to believe that dry rot has the ability to transfer moisture to dry timber and,also, that the removal of the source of water will not halt the activity because dry rot can obtain saturation moisture from the breakdown of timber. Both observations are incorrect as has been demonstrated by laboratory experiment. Dry rot is restricted only to zones of wet timber and masonry. If the source of water ingress is controlled the dry rot will die. Dry dry rot is dead dry rot.

Fruiting body on plaster caused by leaking pipe.

Treatment of Dry Rot

In many instances the treatment of dry rot has resulted in greater damage to the building fabric than could ever have been caused by the outbreak itself through oversaturation with preservatives. In fact, nothing like this volume of chemical is ever used. In the treatment of dry rot and wet rot it is necessary first to locate and eliminate all sources of moisture. Wet rot usually only requires localised repair of the affected timber.

Preliminary Control Measures

(a) *Locate and eliminate all sources of moisture*

(b) *Promote rapid drying of walls.*
This can be achieved by dehumidification, but dehumidifiers are only used in the early phases of drying out and the best results can be achieved by air movement and time. The moisture content of timber should be at or below 16%.

Secondary Control Measures

(a) *Determine the full extent of the outbreak.*
This will involve checking sites of an infestation. This may require limited exposure of lintels,bearings or bonding timbers known to be present.

(b) *Removal of rotten timber.*
Decayed timber should be removed wherever practicable and timber should be cut back at about 300 mm past the last signs of decay.

Decayed wallplate and rafter showing timber to be cut back.

Joist ends supported by steel brackets.

(c) *Preservative treatment.*
Timbers in the vicinity of dry rot should be paste treated or injected about 400 mm past the last signs of decay. Wall surfaces should be spray treated. New timbers should be pre-treated and isolated from walls with a damp proof membrane. Timbers in a damp situation should be impregnated with preservatives to B.S.4072 and timbers

in less-hazardous areas should be dip treated or double vacuum 5268 part 5 and B.S.5589.

(d) *Install monitoring systems*.
Remote monitoring systems can be of great assistance in reducing the cost of maintenance programmes. The placing of sensors at points in the building which are known to have suffered water ingress and deterioration allows for the monitoring of areas which have been closed up and concealed following remedial works. Monitoring systems can detect the moisture levels and indicate when saturation is occurring and when there is a risk of further outbreak of dry rot. Such monitoring systems are increasingly being used in historic building restoration programmes. Continuous monitoring of historic property and regular inspection is more likely to result in control and eradication of dry rot than any attempt at saturation/irrigation. General maintenance should always include the cleaning of gutters,hopper heads and downpipes.

Wood Destroying Insects

The major cause of damage to timber are wood eating beetles which inhabit timber during their grub stage. The emergence of the beetle from the wood leaves the characteristic flight hole on the surface. The most common are the death watch beetle and the furniture beetle.

Common Problems

1.Death Watch Beetle.

This beetle is rarely encountered in Ireland but it has been found in oaks in historic buildings. The grub remains in the wood for four to five years. The flight holes appear in the spring.

Smoke deposited insecticide

This system has been used to control death watch beetle. The treatment can be carried out in open roof spaces. The building should be sealed against smoke losses. The treatment should be timed to be completed by April and the procedure must be carried out in at least seven consecutive years to take account of the life of the beetle.

Reinforcement for oak truss attacked by death watch beetle.

2. Furniture Beetle.

The furniture beetle attacks hard woods and soft woods,including plywood. It affects structural timbers as well as furniture. The grub remains in the timber for up to two years. The beetles emerge from their flight holes from May to September. The size is usually about 2 mm.

Treatment for infected timbers

The timber should be exposed to determine the extent and type of attack. The timber should be cleaned to remove dust and debris. Severely decayed wood should be replaced with new pre-treated timber. Accessible timber should be treated by applying insecticide to B.S.5707 to saturation of 1 litre per square metre of flooring. Both sides of the floor boards should be treated by brush or spray.

Treating furniture, attacked by the furniture beetle, particularly good antique furniture, is best left to an expert.

Dos and Don'ts

Do
- locate and eliminate sources of water ingress
- remember that dry dry rot is dead dry rot
- install a monitoring system where possible.

Don't
- use saturation/irrigation systems unnecessarily.

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