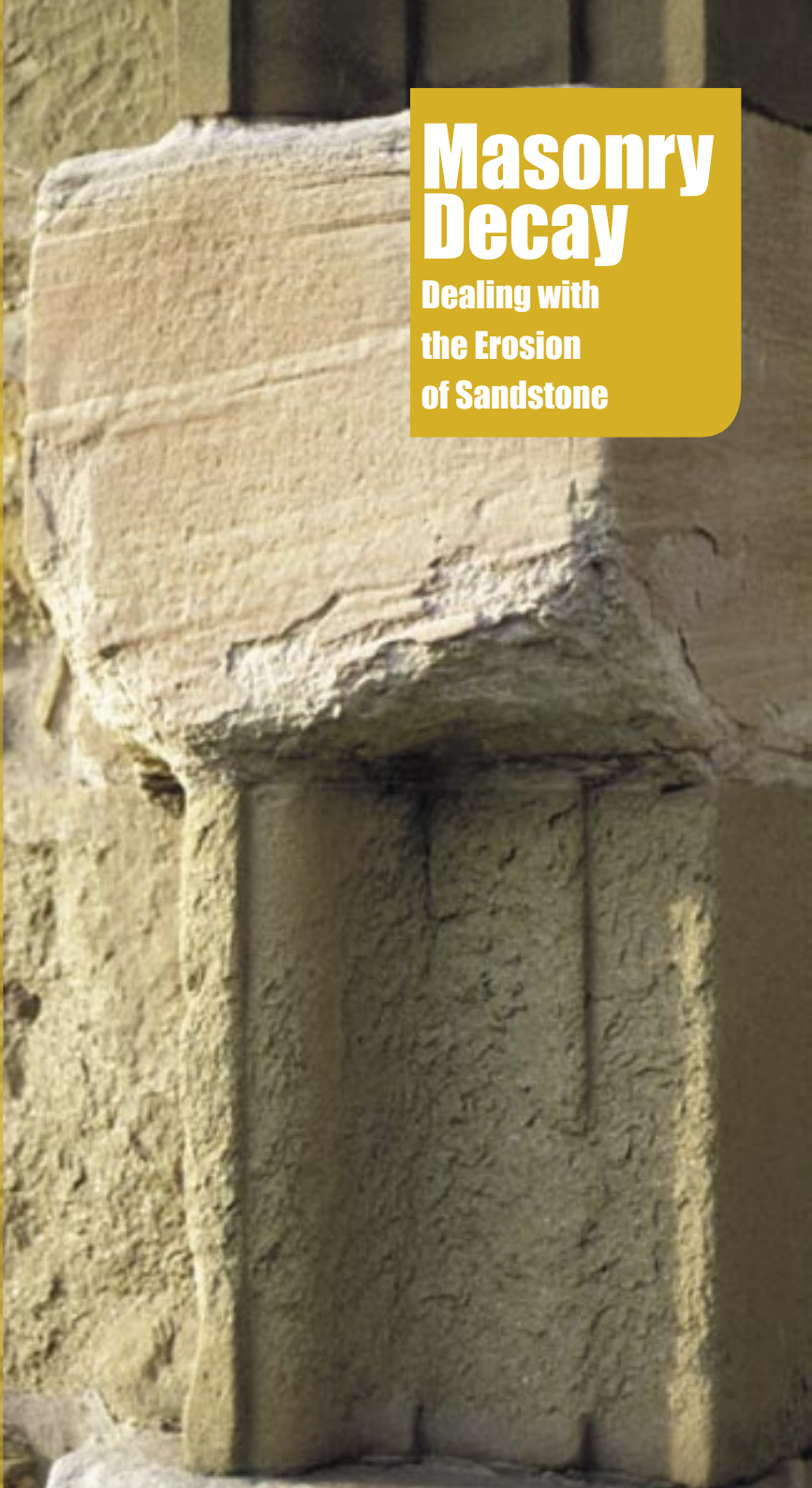
INFORM

INFORMATION FOR HISTORIC BUILDING OWNERS

Masonry Decay

Dealing with the Erosion of Sandstone



HISTORIC SCOTLAND

Introduction

Stone structures have been built in Scotland for over 5000 years. When correctly used and maintained stone is a sound, stable, building material as numerous prehistoric, medieval, Georgian and Victorian buildings will testify. However, all materials decay: some types of stone deteriorate faster than others. Softer sandstones decay faster than harder sandstones and they, in turn, decay faster than granite.

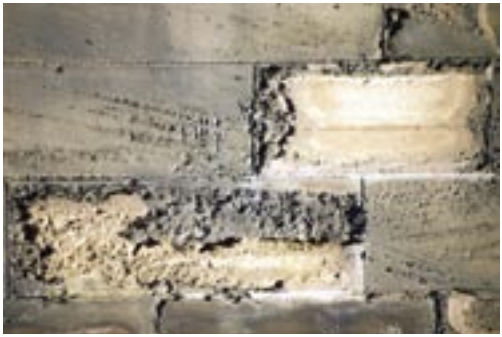
Stone is a natural and porous material. This can make it susceptible to the effects of water. The effects vary, depending upon the type of stone, the position it has on a building and the amount of water it is subjected to. Water acts as an engine of decay. As water repeatedly penetrates and evaporates from stone, it can trigger a variety of processes leading to erosion. The effects are made worse if these cycles are combined with larger volumes of water, exposure to other contaminants, or where carved or moulded stones project out from a wall face.

This guide provides a brief introduction to the range of issues that need to be carefully considered when faced with the problems of dealing with erosion and decay on a traditionally constructed stone building.

Types of Decay

Stone decay manifests itself in many ways. This can lead to different appearances such as:

- A powdery surface of loose grains
- A separating skin (of different thicknesses)
- Penetrating holes, creating a honeycomb effect
- Open fractures crossing stones on unusual angles, or in a “starburst” effect
- Severe partial destruction of individual stones
- A white build-up of salt material on the surface
- Partial failure of projecting mouldings and carvings
- Blistered bubbles
- Deterioration of individual stones leaving the surrounding mortar standing proud
- A general blurring and loss of sharpness
- Tidemarks, water stains, and discolorations
- Wear patterns.



Deciding when to replace an eroded stone

Unless it has become loose or fractured, stone can erode and decay to a considerable depth before causing structural problems that need attention. It does, though, look unsightly and this can influence the decision over when to act.

The difficulty in deciding where to start replacing eroded stonework is matched by an equal difficulty in deciding where to stop. Four main considerations need to be borne in mind when deciding to replace masonry. These are:

- Authenticity: Would retention of original stone preserve the building's integrity and character?
- Aesthetic: Does the appearance of the building depend on architectural completeness, or on revealing the marks of time?
- Structural: Is there real concern about safety, collapse or serious failure?
- Functional: Is the building performing in the way it was designed?

On buildings of historic significance, the survival of original stonework can over-ride the desire for aesthetic uniformity. Where the appearance of a building is felt to be compromised, often the need to replace eroded stone is determined solely on aesthetic grounds. Most 18th and 19th century stone buildings were designed to control the flow of water over their surface. Projecting stones and stone courses act in a functional way to allow water to drip off the building, rather than let it run down the face. Such functional features are seen on chimneys, gables, wall heads, window sills, doorways, horizontal banding at different floor levels, and on the copes of boundary walls.

When they work properly, all of these details contribute to a healthy, dry, structure. When they fail other problems start to appear and, if left unresolved, these will inevitably result in additional costly repairs.

On the other hand some expensive stone replacement projects have been carried out in the past when there was no real need to do so. Frequently, all that is required is the re-pointing of wall faces following a gentle brushing down of any loose material from the building. This approach may occasionally have to be coupled with the removal of any loose pieces of stone that could cause a safety problem, especially if they are too small to be securely reattached. To ensure proper re-pointing work it is important to use lime mortar.

As a general rule the selective replacement of eroded stones should be all that is required. Each wall-face should be structurally sound and effective in stopping concentrations of water from getting into the building. The primary consideration should be to replace eroded stones that were originally designed to throw water off the face of buildings, but no longer do so. That way, the maximum benefit for the costs involved will be achieved.

Remedial Work

Over the last 50 years many changes in the building industry have led to a greater emphasis being placed on the use of modern building materials. This has often been to the detriment of traditionally constructed buildings. Three significant needs have to be resolved when trying to weigh up how to carry out sympathetic repairs to decayed stone buildings. These include finding:

- The right technical knowledge
- Good craft skills
- The right materials.

The Right Technical Knowledge

Knowledge about the construction of stone buildings, and how they should function, was more widespread in the past. This has led to extensive research in recent years and the publication of new technical information promoting a greater understanding of traditional building construction techniques. (See Further Reading List).

Good Craft Skills

Currently, the number of fully qualified stonemasons available to undertake good quality work in Scotland is limited. It will take time for the building industry to address this shortage. Meantime, caution needs to be exercised when planning repairs to buildings where the stonework has decayed.

The Right Materials

Problems can emerge unless replacement stone accurately matches the properties of the original. These can include changes in colour and performance, localised erosion, and difficulties in trying to copy the original appearance left by the masons' tools. Unfortunately, the number of quarries producing good quality sandstone in Scotland and northern England is only a fraction of those that were in business during the 18th and 19th centuries. Initiatives to improve the situation and encourage access to more old building stone quarries are being worked on, but this too will also take time to resolve. Consequently, the availability of good matching replacement stones are limited, and care needs to be exercised in making choices.

Specific Decay Problems

1 Stone Cleaning

From the late 1960s until the 1980s, stone cleaning was a popular practice used to reveal the "original" stone from under what was thought to be dark-coloured damaging surface coatings. We now know that this surface was a natural result of aging and helped to protect the stone. With the passage of time, many cleaning techniques have been proved to be very damaging, particularly to sandstone, as that natural protective layer was destroyed. The original surface was often removed by grinding and blasting, whilst the application of various chemicals created permanent discoloration of buildings that did not reflect the stone's natural weathered appearance. In the worst cases cleaning has increased the rate of natural stone decay and erosion between 6 and 10 times. Regrettably this is now adding to the maintenance costs and needs of these buildings, and will involve a considerable amount of stone replacement work in the not too distant future.

2 Plastic Repairs

The stone cleaning problem has been compounded by the adoption of "plastic repairs" as an inappropriate maintenance technique. Here, a variety of synthetic mixtures have been spread onto the face of badly damaged stones in the misguided belief that they would improve the appearance and performance of the building. Over time the

use of these impervious "plastic" materials inevitably trapped water behind the patch. This has frequently led to the two materials failing where they were originally fixed together, and a number of incidents where the applied repair has subsequently fallen off the wall face, creating additional safety concerns. The applications of such synthetic materials are best avoided.

3 Salt Damage

Damage can occur from a variety of sources, including the laying of salt on pavements or roads close to buildings during winter to prevent ice from forming. As salt is soluble and stone porous, it can be washed into the stone by rain and ground water. As the water evaporates, this can lead to the salt re-crystallising inside the stone. When the salt crystals outgrow the available space in the stone's pores, they exert pressure. This leads to a breakdown of the stone, often resulting in a loose powdery surface with a white appearance. To help prevent this from happening it is best to keep the application of winter salt, and other possible contaminants, well away from the stone courses near the ground.

Preventative Measures

Some simple approaches can help reduce the risk of stone decay.

Building Maintenance

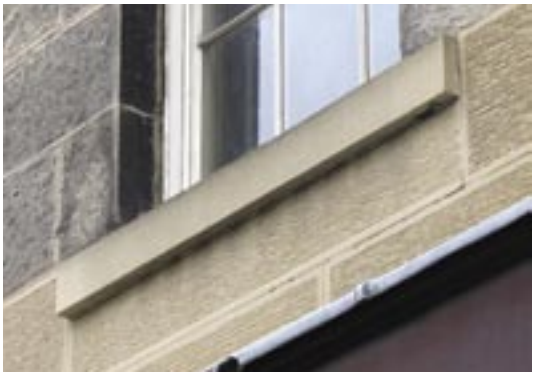
Many stone decay problems begin with the failure to maintain buildings. Splits in lead-lined parapet gutters, missing flashings, fractures in cast iron gutters and down pipes, and failed underground drainage can all lead to high volumes of water being concentrated into adjacent stonework to induce decay. It is best to avoid this risk by carrying out frequent maintenance checks, and remedying any faults or failures as soon as they are discovered. All flashings and rainwater goods should be kept in a fully functional condition, and repairs carried out as problems are identified.

Open joints between individual stones blocks should be re-pointed with an appropriate lime-based mortar. If they are left open for long periods they will encourage biological activity which will progressively encourage moss, grasses, small bushes and saplings to become established in the voids. It is best to avoid any surface growth from becoming established in the first place.

Treatments to avoid

Stone cleaning should be generally avoided or, if it is thought necessary, it should be carried out to the most stringent standards and in the least damaging manner. This should be established through carefully monitored tests. It should be noted that consent is normally required to carry out cleaning on listed buildings and those in conservation areas. Further information on this aspect can be obtained from local planning authorities

Masonry buildings are not constructed in a homogeneous manner, so water will always find a way to penetrate behind a surface coating. While surface applications may keep water out they can also have the reverse effect of keeping water in by not allowing it to evaporate. This can lead to decay. The use of water repellents should be approached with caution, and the use of oil paint coatings avoided.



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Further reading

- TAN 1 Preparation and Use of Lime Mortars
  2005, ISBN 1 903570 42 5
- TAN 10 Biological Growths on Sandstone Buildings: Control and Treatment
  1998, ISBN 1 900168 40 5
- TAN 12 Quarries of Scotland
  1997, ISBN 1 900168 47 2
- TAN 20 Corrosion in Masonry Clad Early Twentieth Century Steel Framed Buildings
  2000, ISBN 1 900168 52 9
- TAN 25 Maintenance and Repair of Cleaned Stone Buildings
  2003, ISBN 1 903570 80 8
- Chemical Consolidants and Water Repellents for Sandstones in Scotland
  2003, ISBN 1 903570 20 4
- The Performance of Replacement Sandstone in the New Town of Edinburgh
  2000, ISBN 1 903570 09 3
- Stonecleaning – A Guide for Practitioners
  1994, ISBN 0 7480 0874 8
- The Repair of Historic Buildings in Scotland
  1995, ISBN 0 951 7989 2 8
- Memorandum of Guidance on Listed Buildings and Conservation Areas
  1998, Visit: http//www.historic-scotland.gov.uk/memorandumofguidance
- Scotland's Listed Buildings: A Guide to Owners and Occupiers
  Visit: http//www.historic-scotland.gov.uk/re-freepublications.htm

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