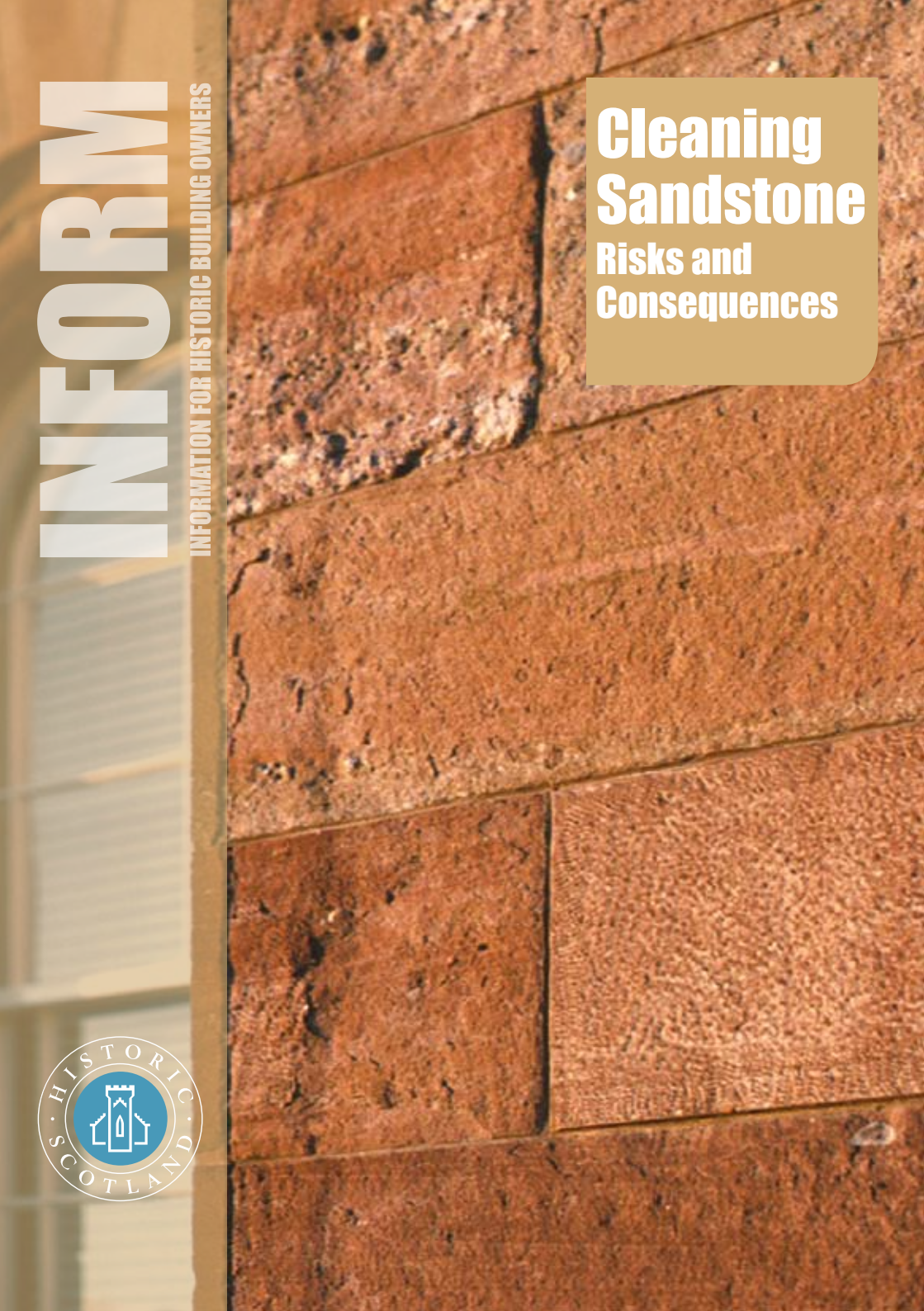
INFORM

INFORMATION FOR HISTORIC BUILDING OWNERS

Cleaning Sandstone

Risks and Consequences



HISTORIC SCOTLAND

This INFORM is intended to appraise building owners of the issues surrounding cleaning sandstone buildings.

Specifically, it addresses:

- **the history of stonecleaning from the 1960s**
- **benefits and risks of stonecleaning**
- **types of surface discolouration found on sandstone buildings**
- **past cleaning methods and their consequences**
- **the need for testing**
- **new developments and technologies**

History

It is unclear precisely when the late 20th century enthusiasm for cleaning stone buildings started to gain ground. It has been suggested that it can be traced to France in 1959, when a century-old law requiring homeowners in Paris to perform regular cleaning of their building facades was revived. By the early 1960s, the apparent benefits of cleaned buildings had caught on in London, where the effect of jet-black Portland limestone emerging sparkling white from under layers of grime was even more sensational.

The desire to clean then seems to have spread rapidly throughout the country with the nation's most prestigious public buildings being used to set the trend and illustrate what could be achieved. Unfortunately, the earliest techniques that were employed have now also been proven to be the most damaging for the stone and many of the subsequent processes

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Benefits and risks of cleaning

During the 1960's and 1970's several positive aspects to stonecleaning were promoted alongside the purely visual argument. Principally, it was considered that cleaning:

- stimulated a sense of pride in the built heritage and contributed to urban regeneration.
- exposed a lighter colour of the stonework to reveal architectural detailing.
- increased reflected light on the surface of stone, leading to a brighter, more welcoming atmosphere at street level.

Consequently, a renewed appreciation of what cleaned buildings might look like resulted in many of them being spared from demolition.

Until relatively recently, stonecleaning was generally undertaken at the lowest cost and without adequate technical understanding, proper specification or supervision. This resulted in the use of a wide variety of techniques, many of which were inappropriate for the building or poorly understood by the workers carrying out the task. Whether through genuine ignorance or commercial motivation, practitioners, manufacturers and suppliers all failed to grasp the real dangers and complexities of cleaning sandstone buildings, and some serious problems emerged.

A key error of early work was to tailor the programme towards removing all areas of soiling in a single treatment regardless of need. This inevitably resulted in widespread over-treatment. Little thought was given to the wide range of surface variations that are found in different sandstones, other materials, construction methods, patch repairs and areas of natural decay that can exist on buildings.

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Surface discolouration

The health and wellbeing of a building is not simply determined by how clean or dirty it is but rather by what is happening on the actual surface of the materials used in its construction. Discolouration can result from three main types of building soiling although, in reality, all three are liable to be found in combination:

- **Particle soiling** – caused by the airborne deposition of vehicle exhaust fumes, sea salts and other contaminants. These are present in the dry atmosphere and in rainwater. This process can lead to the formation of hard black crusts building up on some stone surfaces (although this is more likely to occur on limestone buildings).
- **Staining** – caused by dark coloured minerals such as iron or manganese that naturally occurs in sandstones. These gradually leach out over many years. This is a natural process which can be accelerated dramatically by cleaning. The result is unnaturally 'bleached' or "tinted" stone surfaces.
- **Biological soiling** – algae, fungi, lichens and bacteria each seek out ideal conditions to colonise the stone. Influencing factors encouraging their growth include exposure, orientation, and the functions and positions of stones. By making the surface rougher, or by chemically altering the natural minerals, cleaning can promote biological growth by encouraging rainwater to penetrate into the stone.

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Past cleaning methods and their consequences

Two principal methods of cleaning have been adopted in the past: physical and chemical.

Physical methods have included high and low pressure water washing, dry and wet grit blasting, mechanical cleaning using rotating discs and brushes, and manual dry brushing. Grit blasting and grinding can cause considerable damage in the hands of unskilled operatives. Depending on the system and pressures used, this has led to varying degrees of surface roughening. This can create:

- a much greater susceptibility of the stone to absorb rainwater, dirt and pollution
- 'pitting' of small holes on the stone's surface
- disfigured architectural detail
- erosion of sharp edges and loss of definition
- the complete loss of the mason's original surface tooling
- an unsatisfactory exposed rough surface that encourages surface growths to appear and develop

Cleaning with various hard metal brushes, rotating discs and other grinding devices attached to power tools has been responsible for the severe disfigurement of many of Scotland's traditional stone buildings. Fortunately, whilst the use of such damaging abrasive techniques has almost disappeared, they are still inappropriately used by unscrupulous contractors on occasions.

The only relatively "safe" manual cleaning technique which might be employed involves dry brushing with a stiff natural bristle brush (not a wire brush) and clean water. It can

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be used to remove some organic growth and loosely bound surface dirt but it is only effective on buildings with relatively minor surface soiling.

Chemical methods involve applying a substance which reacts with the stone and any discolouration that exists on the surface. It is then removed, along with the soiling. Both alkaline and acid chemicals can be applied as liquids, gels or pastes (poultices) depending upon the system that is used. Less physically damaging than the cruder forms of mechanical cleaning, chemical techniques have often left a permanent legacy on the affected building by changing its colour, or by leaving residues in the stone. This is partly due to the porous nature of sandstone. No matter how good the attempts are to "rinse off" the chemicals some residue will always be left behind as it is "rinsed into" the open structure of the stone. Due to the effects of gravity, rinsed-off chemicals are also likely to

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remain in higher concentrations on the lower parts of the treated wall, and in projecting architectural details.

The long-term effects of chemical cleaning can include:

- irreversible bleaching or staining leading to changes in the building's appearance and stone's colour
- unsightly white deposits (efflorescence) resulting from residual deposits (salts) being drawn out of the sandstone to crystallize on the surface
- erosion of certain natural minerals leading to 'pitting', and changes to the surface texture with loss of detail
- accelerated "greening" of the surface due to the encouraged growth of algae

Most of these changes are not just unsightly: they can also accelerate stone decay. In the worst cases this can be significant. Many cleaned sandstone buildings that were left in a sound and stable condition some 25–30 years ago are now emerging as requiring major masonry repairs. In addition, an increasing number of previously cleaned buildings are being partially or completely painted over to try to disguise the emerging visual consequences.

The application of thin coloured coats of cement based repairs to damaged stonework was also used as part of the original approach in cleaning projects. Whilst this technique seemed to give some short term benefits, in the medium term it has added to current difficulties and the cost of remedial masonry repair works through encouraging the decay processes. Over-painting, and patch repairing with cement renders, should be therefore be avoided.

Recent research has identified numerous cleaned buildings where the rate of decay is six to ten times faster than adjacent buildings that were not cleaned. The findings also suggest that, in the worst cases, 25 - 50% of all the stone in the cleaned walls may now require replacement. With the considerable number of buildings that have been previously cleaned, projecting these findings into the future suggests that major masonry repair projects will continue to emerge for some time. In consequence, anyone considering embarking on a programme to clean a sandstone building needs to consider the issues involved very carefully indeed.

The need for testing

Owners, particularly those in terraces, crescents and squares, need to take into account the effect of cleaning not only on their own building but also on the rest of the street. In the past, piecemeal cleaning, where individual buildings or elevations were cleaned at different times using different methods, has been responsible for creating some of the worst visual effects.

A thorough testing programme is a vital part of any anticipated cleaning project and will be necessary in advance of writing a relevant specification for contractors. If it is to be carried out properly, testing requires specialist expertise and equipment. Most testing involves three basic stages:

- **Examination** - Inspect the building systematically. Defects, surface variations, decoration, stone type, soiling patterns, and the impact of weather and water run-off on different areas of the building should all be recorded and the implications of these issues fully considered.
- **Test Cleaning** - Several areas should be identified for testing. These should be on unobtrusive parts of the building and be appropriately representative of the range of established surface variations that exist. How exactly this stage is to be carried out will vary according to which methods are to be used.
- **Reporting** - Test results should be thoroughly analysed and reported on by comparing them with observations performed during the examination stage. A comprehensive report, including photographic evidence, should be prepared. All of the information recorded during the testing process should be retained for reference, in the event of something going wrong with any future work.

Once a decision is made to go ahead with cleaning, an equally important issue is deciding when to stop. Even the most cursory investigation of previous-cleaned buildings illustrates how complex a decision this is to make. This can be particularly problematic in urban areas, as legal boundaries of building ownership do not always coincide with the architectural design. In addition problems can arise from an overzealous approach by site workers. This can lead to considerable damage being caused to architectural features and details in the desire to achieve what is perceived as the "best" results on the job whist work is progressing. Adequate control of the work is called for in such circumstances.

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Once cleaning has been decided upon, the next steps involve selecting a suitably experienced contractor. The training and experience of their workforce, how they ensure effective site management and uphold all health and safety precautions should be checked out. For future reference, keeping an adequate record of work carried out at every stage of the process is also

New developments and technologies

Over the past decade, an emerging awareness of the amount of damage that had been previously caused has been supported by a considerable amount of new research. This has prompted the stonecleaning industry to devise a number of new techniques and applications. These include latex poultices, the use of bacteria, and lasers. Past experience has shown the need for exercising caution with any new approach. Each of the new techniques should therefore be approached with care, appropriate testing and adequate investigation. It should not be forgotten that the safest way of avoiding the risk of damage to a sandstone building from any form of cleaning is simply not to clean in the first place.

Listed buildings and buildings in a Conservation Area

Protected buildings present a particular issue as consent to clean will be required. Since 1992, in Scotland stonecleaning has been considered an 'alteration' and any cleaning project requires consent if it is to be undertaken on a listed building, or on a building in a conservation area. It should be noted however that there is a general presumption against cleaning in most cases.

Useful contacts:

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Further reading

Stonecleaning – A Guide for Practitioners
Historic Scotland, 1994, ISBN 0 7480 0874 8

TAN 25 *Maintenance and Repair of Cleaned Stone Buildings Historic Scotland*, 2003, ISBN 1 903570 80 8

Laser Stonecleaning in Scotland – Research Report
Historic Scotland, 2005, ISBN 1 903570 79 4

Cleaning Techniques in Conservation Practice
Donhead, 2005, ISBN 1 87339474 8

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