THE Maintenance OF HERITAGE ASSETS

INFORMATION SHEET 6.1

CLEANING MASONRY WALLS

INTRODUCTION

Building exteriors of face brick, stone or unpainted render need to be cleaned occasionally to preserve the aesthetic and physical integrity of the masonry.

This may involve:

- removing corrosive deposits
- improving the appearance of the building
- exposing dangerous masonry cracks prior to repair.

These guidelines cover:

- selecting the right cleaning method
- types of surface deposits
- removal techniques
- advantages and disadvantages of each method.

1. SELECTING THE RIGHT METHOD

The aim of any cleaning method is to remove the surface deposit with as little effect as possible on the fabric of the building. In some situations, however, it may be impossible to avoid removing some of the masonry, particularly where:

- paints have penetrated the surface
- industrial grime has reacted with brick or sandstone.

Cost and potential damage are the main factors in deciding on the system to use. Cost is not just that of the cleaning system alone: for example, a cheap alkali clean may lead to serious salt-damp fretting which does not show up for some time, but causes long-term damage.

Carelessness or the wrong choice of a cleaning method can lead to irreversible damage to the building. This is one good reason to leave cleaning operations to the experts. Another is the need to be aware of the safety and environmental issues involved.

The appropriate method for cleaning a building will depend on the types of masonry substrate and surface deposits to be cleaned.

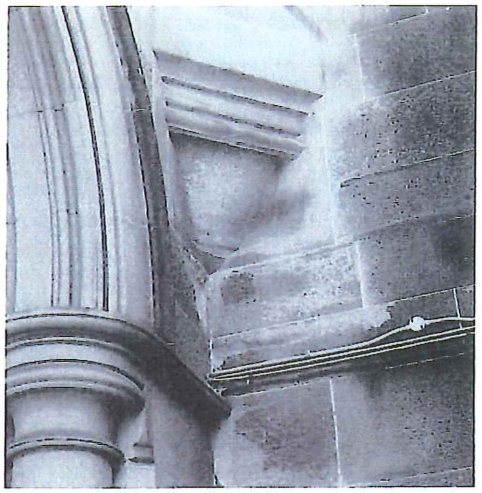
2. SURFACE DEPOSITS

The common types of soiling on masonry are listed below, with an indication of the usual method for cleaning each type of surface deposit. These methods may not be suitable in certain cases, and care must always be taken to determine the best method for cleaning in each instance.

Organic growths

Organic growths are usually associated with damp in buildings. They will reappear unless this basic problem is solved. Moss, lichen and mould are easy to recognise. In some instances moulds can be mistaken for staining from gutter flows, which can be treated in the same way as light industrial grime.

Mould and algae growth on St. Mary's Cathedral, Sydney



Photograph by Anne Higham

Alkalis or abrasive methods are commonly used for removing organic growths. It is better, however, to kill the growth with steam or a fungicide and allow the organic matter to weather away. This leaves the masonry undamaged. On some southern walls repeated treatments will be necessary because their lack of exposure to sunlight encourages dampness and continued growth.

Ferns and shrubs should be killed with a herbicide, excess foliage cut away and roots left to decay. Repointing may be necessary later. If the area is inaccessible and liable to water ingress the roots should be gouged out and repointing done immediately.

After the removal of mosses or moulds, apply a durable toxic wash based on paint type 32 to AS 2311. Do not use a copper-based product as it will mark most surfaces. Avoid washes containing formalin or phenol - they are too toxic.

Light industrial grime

Use a mild abrasive technique, such as hand or mechanical brushes (bristle or bronze, not steel) or water jets. Bird droppings can usually be removed by this method. Detergents and hot water can be effective, but test them first. Although this seems a simple job, the dirt may not have settled evenly on the building, and achieving an even result from cleaning can be difficult.

Heavy industrial grime

Heavy grime often penetrates the masonry and reacts with it. Use alkaline gel for a moderate clean. Steam cleaning may be used on strong concrete, strong cement render or hard stone such as unpolished granite if repointing is to follow.

Sound paintwork

Assuming the paint is to be completely removed, use either a methylene chloride solution or gel or caustic solution or gel to remove all paint layers.

For thin coats of acrylic paint use a hot air gun. On sound masonry pressure cleaning with water-entrained grit may be effective, but great care must be taken to prevent damage to the masonry surface and pointing.

Peeling paintwork

Gel removers containing methylene chloride are preferable to alkaline cleaners. Manual scrapers and hot air guns can be effective.

Graffiti

Begin cleaning as soon as possible after the graffiti appears. Check to see whether a graffiti inhibitor has been applied to the surface previously, and follow the instructions of the manufacturer of the inhibitor. Do a test first on a small section.

For acrylic, epoxy or alkyd paint graffiti use a paint remover with a bristle brush or medium-pressure water jet. Remove spirit pen and aerosol paint graffiti by scrubbing with a solution of detergent and warm water. This method may not be successful with spirit pen graffiti.

Water under pressure is used to remove graffiti from a wall treated with a graffiti inhibitor

Photograph by Sean Johnson

It is usually best to remove graffiti by treating the whole of the affected area to the margins of the individual blocks. If the remover works by softening the paint film, however, it is better to restrict the treatment to the actual paint surface.

Rust and copper stains

Rust stains can be removed by a diluted solution of orthophosphoric acid. A 15% solution of sodium citrate is useful for rust stains on marble.

The green stains caused by run off from copper roofs and fittings can be removed by careful washing with diluted ammonia solution. Be careful not to let the solution spill onto other areas of the building.

Tar, pitch and chewing gum

Mechanical scraping or steam-cleaning are the best way of removing these deposits. They can also be frozen with dry ice and chipped off if they are localised. Tar usually needs washing with hot water and detergents, or organic solvents in a poultice.

Efflorescence and weathered stone

Sheltered sections of the exterior fabric can develop a slow build-up of water soluble salts, which can cause the flaking or fretting of stone and soft brick. In this case it is important first to lightly chisel off the fretting masonry (preferably done by a mason) and any efflorescence should be removed with a dry bristle brush, before general cleaning begins. If these salts are not removed they can soak back into the masonry and cause further deterioration. Further steps may be necessary to reduce salt levels within the stone.

It is difficult to remove gypsum in marble efflorescences. Wash with EDTA salt solution.

3. WHEN NOT TO CLEAN

Not all of the deposits on buildings are harmful. Thick iron deposits on sills and ledges maybe the result of spark fragments from Sydney's electric trams. Scratch marks at sill level around doorways and columns are evidence of early wax-vesta matches from the days of gas street lighting.

Although these deposits could be removed (the wax match marks by strong alkalis and the iron deposits only with harsh abrasive methods), they do not cause damage to the building fabric. There is a case for leaving them alone because of their historical significance.

4. TESTING

Always test small areas before carrying out the full job. If these tests are successful, try out the equipment and cleaning materials to be used on an area of 1-2 square metres. This area should be a representative but discrete section of the surface to be cleaned and next to an identical uncleaned area so that comparisons can be made.

Remember that there is a big difference in scale between a test area and a large wall. In particular:

- a small area will always look less clean than a large area. If the test area looks right, the effect on the whole wall may appear too clean and characterless;
- you can't expect to replicate the full range of variations in a small test area, so allow for flexible treatment on the full surface;
- there are problems which will apply to the large area but not to the test, such as the drying-out of chemical solutions or run-down, which can cause streaking in the lower areas as the upper area is cleaned.

Cleaning trials at St Mary's Cathedral

Photograph by Anne Higham

5. CLEANING METHODS

The following cleaning methods have been used to clean buildings. All of the methods listed can be detrimental to the building if not carried out correctly or if they are inappropriate to the surface material or the type of deposit. This is why testing should always precede any large scale work.

Water

Water is generally the simplest and safest method of cleaning masonry:

- wet the affected area well, and scrub with a firm bristle brush;
- use cold water at first, then hot water if cold doesn't work. A controlled medium pressure spray fan jet is acceptable. Fan jets are good as they are easy to control and can keep the abrasion factor reasonably low;
- calculate the "abrasion factor" (see box). The factor should generally be kept below about 2,000 for normal sound sandstone, but even this could be highly damaging for softer materials (including jointing).

ABRASION FACTOR

$\frac{pq}{a}$; where

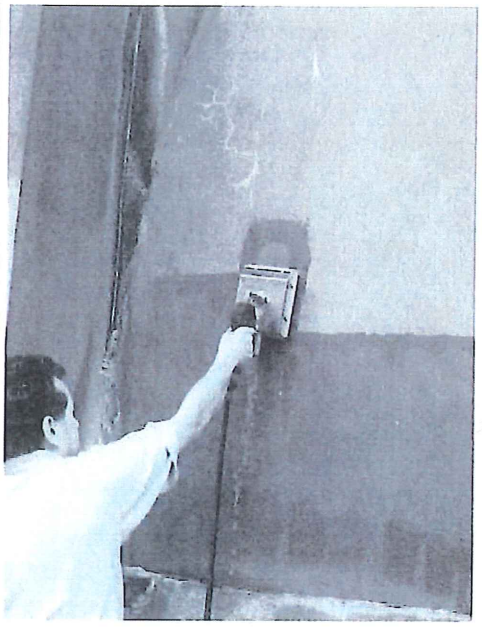
p = pressure in kPa

q = flow rate in litres per minute; and

a = the area of wall (in square cms) covered by the main jet.

A captured jet water system is best used for pressure cleaning as it contains the run off of soiled water for proper disposal, and reduces the likelihood of it staining the wall below.

Cleaning by captive water blasting method on the approaches to the Sydney Harbour Bridge



Photograph by David McBeath

Mist sprays, if used for a number of days, can soften heavy dirt build up on masonry. Alternatively, water can be run over the facade. However, apart from the question of water wastage, the problem with these methods is that they can lead to interior water penetration and aggravation of existing damp problems. They have been successful in Europe, but are relatively untried in Australia.

Detergents

Neutral liquid detergent

Teepol (Shell PMCL5012/1 /77) is a neutral non-ionic detergent which contains no dissolved salts. Use a concentration of 1 part Teepol : 20 parts warm water. Pre-wet the area and apply the detergent solution. Scrub with a bristle or bronze-wire brush. Wash with a medium pressure water jet, using hot water.

Alkaline detergent

Use cloudy ammonia or other diluted hydroxide solution. It is important to test these chemicals before using them on a large surface, as they can cause severe salt efflorescence and bleaching if they are not used in the recommended proportions, with proper pre-wetting, protection and washing after application. Scrubbing is usually necessary. Repeat the process if required, but don't attempt to neutralise the detergent with acids.

Face protection and gloves are necessary if alkaline detergents are used. Solutions must not come into contact with glass, paintwork, duco, polished wood, plastics, aluminium, plaster, plants or clothing. Prevent their seepage into pointing cracks or foundations. Caulking with hemp or string is usually an effective preventive measure.

Stronger Chemicals

Mineral acids are effective cleaners, as they attack or dissolve the unwanted material, but their corrosive effects can be disastrous. Heavy dilution is necessary to prevent this. They are not recommended for marble or sandstone. In any case, full protection is necessary for personnel.

Another side-effect is that they produce salts which can move into the pores of the masonry despite heavy washing. These then recrystallise and cause the surface material to decay.

Avoid splashing acid on marble or Bowral trachyte, glass, ceramic tiles or metal (especially lead). Observe all safety requirements and the regulations on the disposal of acid wash water and prevent it from soaking into vegetation or foundations.

Hydrofluoric acid, including bifluorides (acid salts), should not be used except by expert applicators in the case of heavy industrial grime on very sound surfaces, and where less aggressive agents have been unsuccessful.

Alkaline gel is an effective "poultice" method for removing paint or graffiti. Wet the area thoroughly, allow some time for surface water to run off, and apply the gel when the surface is just damp. Wait, then wash off using medium water sprays, non-scouring scrapers and brushes. Repeat as often as necessary to produce a satisfactory result. You could have the same problems as with alkaline detergent unless you observe all the correct procedures.

Organic solvents

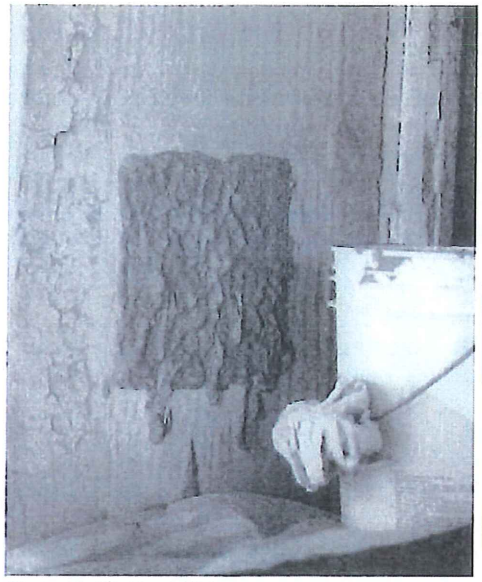
Solvent is added to a detergent solution to improve its performance. It is particularly important to test it before using it on sandstone. Most solvents are toxic and flammable and can smear surfaces or react with the substrate.

Usually solvents are included in a poultice of cornflour, clay or absorbent paper, or mixed with these materials and used as a gel.

Paint removers are caustic compounds which are not specifically designed for masonry cleaning. Some can actually damage stonework or soft brick. They are a last resort if other cleaning methods have failed.

Wet the area and apply the remover. Wait the specified time and remove the paint with a medium pressure water jet, scrapers and brushes. Repeat as required.

A small area is tested using an alkaline poultice to remove lead-based paint



Photograph by Anne Higham

Mechanical Methods

Blow-torches and **burners** have been used to remove paint from concrete, hard brickwork and even cement render, but they have now been superseded by the **hot air gun**, which is particularly effective for removing thin films and acrylic paints. It can cause problems if the substrate is wet, and should be used carefully on drummy render.

Rubbing should only be used as a last resort. It always damages the substrate because the treatment involves the removal of the outer layer of the material.

It is only suitable for concrete, or for stone with a smooth rubbed surface under the supervision of a banker mason. Clean by hand, using a carborundum block and water.

Grit blasting should generally be avoided. Use it only on surfaces which will not be damaged, such as strong sound concrete with a non-smooth surface or unpolished granite. The mortar on old sandstone walls is usually too soft to withstand grit blasting. It also erodes the protective surface from sandstock bricks. Seek expert advice before going ahead with this method.

Water-entrained grit

Grit abrasion can be carried out by means of a water jet and either with or without air-entrainment. Both are especially effective with hot water. The first process uses a variable stream of air in the water jet, which is less damaging to masonry. A similar, more muted effect can be achieved by using a fine limestone grit instead of the usual silica.

One proprietary method of air-entrainment uses a mixture of air, water and fine granules in a low pressure rotational vortex created by a special nozzle. This method can be used on most surfaces if carefully handled.

Steam cleaning is suitable only for rough or off-form concrete, dry-pressed bricks with cement mortar, or unpolished granite or bluestone. It can also be used on cement render, but only if the adhesion is sound.

A lime deposit is cleaned using a special nozzle and a mixture of air, water and fine granules

Photograph by David McBeath

6. EFFECTS OF CLEANING METHODS

The physical or chemical features of the building material can affect the choice of cleaning method. If it is highly impervious, strong and chemically inert, you may be able to select a cleaning method primarily on the basis of efficiency and cost.

Mortar, concrete and most sandstones are affected by hydrochloric and sulphuric acids. Even after washing, these chemicals could cause long-term weakening and streaking. Sulphuric acid can even cause efflorescence.

Apart from possible colour changes, alkaline compounds do not directly affect brick, sandstone, lime, cement render or concrete. If they penetrate a permeable wall or its foundations, however, they can cause efflorescence, fretting and serious damp problems.

The effects of mechanical abrasion are obviously more damaging for a weak surface than a solid one. This is also true of steam-cleaning or blow-torch stripping. The surface cohesion of the material depends as much on its profile as on its strength. A water jet which does not affect ashlar stone may seriously damage carved stone of identical material.

The following checklist summarises the effects of the various cleaning methods on different building materials:

Hard brick and cement mortar

- avoid sandblasting
- use acids only where necessary (e.g. strong grime)
- use only soft bronze wire or bristle brushes
- pre-wet surfaces and protect foundations before applying alkaline cleaners.

Sydney sandstone

- acids cause bleaching and uneven iron oxide colouring

Lime mortar

- acids cause weakening

Polished stone

- don't use acids on limestone, marble or Bowral trachyte
- acids other than hydrofluoric acid and bifluorides can be used on granite, but may affect old mortars and pointing

Clay-rich sandstones and soft sandstock bricks

- seek expert advice before using chemicals on these materials

Concrete

- will accept harsh abrasion and chemicals if the surface is rough
- acids may cause delayed efflorescence

Cement render

- remove drummy render and repair before cleaning
- check for surface cracks before cleaning
- don't use acids except for strong industrial grime.

7. SAFETY AND ENVIRONMENTAL CHECKLIST

All chemical products must have a safety data sheet that is available from the manufacturer. Obtain these sheets and observe the recommended safety measures.

Water conducts electricity. Power lines and electrical equipment are potential hazards if water cleaning techniques are being used.

Spillage of chemicals or detergents can be disastrous, particularly in concentrated form.

Most solvent cleaners are both toxic and flammable. They can attack the skin and cause serious eye problems. Ventilation must be good and the public must be protected.

Alkalies are corrosive to skin, hair and clothing, and can cause blindness if sprayed into the eyes.

Acids, particularly hydrofluoric, and bifluoride solutions can penetrate the skin, even in diluted form.

Abrasive methods create dust. Old paint dust has a heavy content of lead which is a cumulative poison.

Contaminated residue from the cleaning may have to be disposed of to designated dumps using special procedures.

8. SUMMARY OF GENERAL PRINCIPLES

Be sure you are clear why the building is being cleaned. Over-cleaning of older buildings is a common problem.

Select the cleaning method that is appropriate for the job and the condition of the substrate.

Understand the dangers and guard against them. Test the proposed method.

Don't just choose the contractor with the lowest quote - check they have the right skills and experience.

Remove graffiti as quickly as possible.

Prepare for repainting by cleaning back to the surface.

Seek advice if in doubt.

Always adhere to safety advice and environmental guidelines.

FURTHER READING

Refer to other publications for more detailed information. Alan Spry's *Principles of Cleaning Masonry Buildings* is particularly useful.

Clifton, James R. (ed) 1986, *Cleaning Stone and Masonry*, American Society for Testing and Materials, Philadelphia.

Grimmer, A. E. 1987, *Keeping it Clean: Removing Exterior Dirt, Paint, Stains and Graffiti from Historic Masonry Buildings*, National Park Service Preservation Assistance Division, Washington D.C.

Spry, Alan 1982, *Principles of Cleaning Masonry Buildings: A Guide to Assist in the Cleaning of Masonry Buildings*, Australian Council of National Trusts, Melbourne

ISBN 1 876415 02 9

HO 98/13

March 1998

Endorsed by the Heritage Council of NSW Technical Advisory Group for Materials Conservation (TAGMAC)