



ABOVE: St Patrick's Basilica, Fremantle

INTRODUCTION

Clean, well-kept buildings are more attractive and saleable than those which appear to be neglected. Patina - the beneficial chemical transformation of the surface of the stone during exposure to the elements - may also be important and attractive.

Cleaning/maintenance programs can be the first phase of a complete renovation package designed to improve the public image and the occupancy levels of a historic building. It should however be kept in mind that the buildings we are cleaning today are there not only for our own use and enjoyment, but also for future generations; and that cleaning can be beneficial or harmful according to the type of masonry, the method used and the amount of care taken in its implementation.

The overriding consideration should always be to limit cleaning to the minimum necessary. Much damage has been done to buildings by overcleaning. Cleaning methods should be chosen according to both the degree and type of soiling, the nature of the material to be cleaned and the effect of the method on adjacent elements and materials.

Cleaning should be undertaken only if there is a strong justification and if the soiling can be removed without any damage to the fabric.

The gentlest means of cleaning are the best.

FOR & AGAINST

The following factors should be considered before cleaning.

For:

Cleaning can help to preserve masonry by eliminating factors such as heavy accumulation of surface 'dirt' or paint coatings which can slow or stop evaporation of moisture from within the masonry, thus provoking decay due to excess moisture.

Proper cleaning procedures can remove at least some of the harmful atmospheric deposits and help to slow down decay.

Careful cleaning can make existing damage more visible, by revealing cracking or missing mortar joints which are otherwise hidden by stains or accumulated dirt.

Removal of accumulated dirt may reveal a wealth of detailing, colour and textures.

Stone decay is accelerated by:

Soluble salts present in polluted rain water. These are carried into the masonry substrate and, as they dry and recrystallize, they generate pressure which can fracture the masonry. Where sub zero temperatures occur, freezing of water can have a similar effect.

Corrosive liquids (such as sulphuric acid, nitric acid and carbonic acid). These are formed by the reaction of wet and dirty surfaces with atmospheric gases. These can etch some materials, dissolve mortar and stain materials (as well as encourage the formation of hard surface crusts).

Growth of micro-vegetation. These growths are encouraged by moist and dirty surfaces. They increase the moisture retention of the masonry and may form corrosive secretions.

Against:

It can be expensive and destroy the patina of old buildings.

If not appropriately carried out, cleaning can damage both the building fabric and its internal decoration.

Its effect may be short lived.

Indiscriminate cleaning may do far more harm than good and accelerate building deterioration.



ABOVE: St Patrick's Basilica

BELOW: St Patrick's Presbytery, Fremantle



BEFORE CLEANING

The following steps should be taken before cleaning the building:

The cleaning system under consideration should first be tested on small unobtrusive yet representative areas to establish the amount of cleaning required, the feasibility of the system and the optimal strength and combination of its components.

Test areas should be chosen to encompass the range of soiling and substrate types that will be encountered in the course of cleaning.

Original ground levels should be established and usually reinstated prior to cleaning to prevent recurrence of staining caused by rising damp (when moisture enters the fabric of a building from wet soil).

Areas of heavy soiling or staining which may not respond satisfactorily to the cleaning process should be identified.

A specification detailing all aspects of the cleaning process should be provided.

Provision should be made in the specifications for appropriate and safe scaffolding, plant, clean water supply, drainage, safe storage of materials and removal of debris.

The building occupants should be forewarned and should know what to expect whilst cleaning is in progress. An arrangement should be made with somebody inside the building who can quickly bring problems to the contractor's attention.

Rainwater heads and gutters should be protected from blockage by residues.

Signs, light fittings and vegetation should be removed or protected from damage.

All windows, doors and wall openings are to be sealed to prevent the entry of water, fumes, dust or chemicals.

Cracks and open joints should be plugged to prevent water penetration. A synthetic rubber compound could be used.

Glass, painted and polished surfaces should be protected (coats of peelable plastic compound, polythene sheeting or hardboard sealed at the edges can be used).

PATINA OR DIRT?

It is important to distinguish between soiling and the patina acquired by the masonry over time.

Patina may be defined as a beneficial chemical transformation of the surface of the stone during exposure to the elements. It is an important part of an historic building and must be preserved. Cleaning should not interfere with it.

In addition to the chemical patina which may colour or darken the surface of the stone, many buildings acquire a colour that is largely due to windblown dust.

Even in the city dust can contribute significantly to the colour of a building and, unless it can be demonstrated that the dust is promoting decay, it should be left untouched.

Weathering, in the absence of pollution, is therefore, to a certain extent, a natural and desirable process. Some natural products of weathering could however be described as pollutants in that they are harmful (e.g. weak acids produced by lichens and algae).

Dirt is typically a mixture of elements which include fallout from domestic fires, traffic exhausts, power stations and industrial processes.

The pollutants deposit on the surface as minute particles creating a greater surface area. This in turn attracts more dirt, holds atmospheric pollutants and retains moisture. The pollutants react with the masonry causing deterioration of the surface.

CLEANING METHODS

All cleaning methods suitable for use on historic buildings require specially trained personnel.

The three basic methods for cleaning masonry surfaces are:

- water cleaning
- chemical cleaning
- abrasive cleaning.

Methods are often combined to achieve optimum results.

Water cleaning

This includes misting (which uses little water), washing - including spraying (mains pressure) and pressure washing (measured in psi or KPa) - and steam cleaning.

Misting

Misting, because of the very small amount of water used, is the most gentle and therefore the best way to use water for cleaning historic buildings.

This technique requires compressed air which, mixed with small quantities of water, produces a nebulized water mist through jets evenly spaced and in proximity of the area to be cleaned. The temperature of the water may be varied depending on the type of dirt and the surface to be cleaned. To be effective and avoid drifting the mist must be enclosed by sealed scaffolding.

The advantage of this technique is that it can provide sufficient moisture, over a prolonged period, (usually 1 week) to soften and loosen dirt while minimising the amount of water used, consequently greatly reducing the risk of water penetration.

Automatic pre-programmed switching can reduce the consumption of water, further limiting the risk of absorption through the wall.

Washing (including spraying and pressure washing)

It can be one of the gentlest processes. Obviously only fresh clean water must be used either cold or warm to hot depending on circumstances. The force with which the water impacts the surface affects both the cleaning power and the potential for damage.

The greatest risk with the use of water is its penetration into the building because of too high pressure, the use of excessive amounts, the inadequate sealing of the building, or inadequate drainage of run-off water. Therefore great care must be taken to ensure that the water does not penetrate the building.

The pressure of the water should be controlled by accurate pressure regulators and gauges which can be pre-set and locked at a maximum specified level. The water-pressure should be established on the basis of the type of stone and specific conditions and it should ideally be below 200 psi (1379 KPa).

On hard stones such as granite and slate, under specific controlled conditions, a higher pressure may be acceptable (up to 1500 psi = 10342 KPa). The pressure of 800 psi (55160 KPa) generally used for high-pressure water cleaning, is not acceptable for use in the cleaning of historic buildings.

Steam cleaning

This process uses low-pressure steam (10-30 psi = 68-206 KPa) which is directed against the masonry surface through a nozzle. By the time the steam hits the surface it has cooled down to a spray with a minute amount of hot water. The density of the steam can make it difficult for the operator to see and the very high temperature is a potential hazard.

Steam cleaning is a very slow process but can be useful to soften oily deposits and greasy or tarry stains, or remove vegetation clinging to masonry.

Chemical cleaning

This may be carried out using the following:

Organic chemicals (organic solvents and detergents).

Organic solvents are used in paint strippers and paint removers (i.e. removal of graffiti) and can be useful in the removal of some stains.

Surfactants or detergents used for cleaning of masonry should be of the non-ionic type. These can be used effectively with hard water at low temperature and easily removed.

Inorganic Chemicals (acid and alkali cleaners and inorganic salts)

Acidic cleaners

Hydrofluoric acid (HF) is the only acid that does not form dangerous soluble salts during the cleaning process. However, it is exceptionally dangerous to use and has to be handled with extreme care.

Gloves, eye and full body protection must be worn. It should never be used at concentrations exceeding 5 per cent. When possible use in a more diluted form. It should not be used on polished surfaces as it will etch granite, glass and marble.

Acidic cleaners should only be used under the guidance of a masonry expert and then only on areas of excessive soiling on strong sandstones. (In rare cases they may be used on other hard stones.)

Rinsing is required afterwards and periodic checking of the Ph levels in the masonry surface is essential.

For more information on protective equipment and safety measures contact WorkSafe on 1300 307 877.

Alkaline cleaners

Ammonium hydroxide (ammonia in water solution) is an alkaline cleaner which can be used on calcareous (containing calcium carbonate) materials. It can be useful for removing stains.

Many commercial alkaline cleaners are based upon sodium hydroxide (caustic soda). These should not be used on friable, weak or historic masonry because of the quantity of soluble salts that are deposited in the masonry leading to salt attack and decay.

Mechanical or abrasive cleaning

This involves wet or dry sand or grit blasting, dry brushing and manual abrasion.

Blast cleaning was developed for the removal of rust from industrial iron work and is potentially destructive when applied to masonry. Excessive pressure and a lack of operator precision and control usually result in the destruction of the surface layers of brick or stone.

Notwithstanding the above comments, some wet grit blasting methods (if used with skill and care) may be appropriate. A nozzle pressure below 100 psi (700 KPa) should be maintained. Careful testing of the method should be carried out beforehand.

Fine cleaning of details can be successfully done by a specialist with miniature air abrasive tools.

Manual abrasives (such as medium sand paper) may be useful for the cleaning of small patches of encrustations on flat surfaces.

Dry brushing with a plastic or bristle brush and scraping with a non-metal scraper can be used for the removal of loose built-up dirt.

Grinding equipment such as grinding wheels and pneumatic hammers must never be used for the cleaning of historic masonry.

Heat cleaning

Open flame heat lances or heat guns put considerable strains on the surface of masonry, leading to spalling of the surface of most materials. They must not be used to clean historic masonry.

Cleaning of very delicate masonry

A specialist should always carry out this type of cleaning.

The following methods may be used:

Radiation in the form of laser beam or visible light radiation (for small areas only).

Poulticing: poultices usually consist of a support medium (e.g. clay) and are designed to hold a solvent or cleaning agent on the surface of the masonry. The poultice softens the dirt which can then be easily removed and often comes away with the spent poultice. Highly absorbent clays such as attapulgit, sepiolite and palygorskite, mixed only with water, are often used to draw salts from masonry. Poultices are mostly used for small size areas or details which need special attention. They can be very useful in the removal of stains and graffiti.

General rules

The rapid evaporation of water and solvents on walls heated by sunlight reduces the contact time of the cleaners and the effectiveness of the rinsing procedure. This promotes the re-disposition of dirt due to the quick drying of cleaned wall areas. Cleaning should therefore not be done in full hot sunlight. Shading of walls should be provided where necessary.

All brushes to be used for cleaning operations should be of natural bristle or soft plastic type; bronze wire brushes can be used when dealing with strong sandstone.

Use only scrapers made of wood or soft plastic.

Ferrous (iron) brushes are not to be used for the cleaning of masonry.

MASONRY MATERIALS

Each masonry material responds to and is affected differently by the various cleaning methods. Outlined here are all the most appropriate ways to clean some of the buildings stones most commonly used in Australia.

Most dense stones such as granite, marble, bluestone and slate as well as hard brick can be cleaned with either cold or hot low pressure water sprays followed by light scrubbing, or with the misting technique.

Limestone and marbles

These materials are highly acid-sensitive; chemical cleaners for these materials must consequently be neutral. Great care should be taken and the appropriate tests made before cleaning.

Limit the amount of water used because these stones can be dissolved by water and damage to the surface may occur.

Sandstone

Sandstone consists mainly of silica, which binds the dirt to the surface. Silica is virtually insoluble in water and washing with water is not successful. Sandstone will however respond to acidic cleaners, the type and strength of which must be accurately chosen to avoid disastrous effects. Testing of pH should be carried out after rinsing to make sure harmful residues are not present.

Great care must be taken when using chemical cleaners to determine the constituents of both masonry and cleaner. Harmful chemicals such as hydrochloric acid (muriatic acid) and sodium hydroxide (caustic soda) should be excluded.

Slate, unpolished granite and terracotta

These can sometimes be cleaned by water spray but it may be necessary to use hydrofluoric acid together with orthophosphoric acid in very diluted form (less than 5%).

They must be handled with extreme care. Hydrofluoric acid dissolves rocks and etches glass. Unpolished granite can change colour if exposed to hydrofluoric acid so care must be taken to find the correct concentrations. Always rinse thoroughly afterwards. Slate rarely needs acid cleaners.

Caustic soda cleaners should never be used.

Calcareous sandstones

These consist of sand particles bound together by calcium carbonate.

For cleaning they should be treated in the same way as limestones. Acidic cleaning agents should not be used as they may dissolve the calcium carbonate.

Rendering

Depending on hardness and strength, render can be cleaned using low pressure water sprays or genuine misting.

Bluestone

Bluestone used is generally dense and can be cleaned by washing or low pressure water jets. The lime mortar between the stones is however very soft (or it should be) and is easily eroded.

Polished surfaces

Polished granite and marble should be washed with water preferably without using detergents.

Soft stones and soft bricks

These can be damaged by the gentlest scrubbing. Even low pressure water spray can be too abrasive. Very fine water sprays or misting combined with scrubbing with a paint brush could be successful. Cleaning is usually not recommended.

SELECTING A CLEANING SYSTEM

In most cases a cleaning system which does not alter the physical condition and appearance of the masonry will probably call for a combination of techniques.

To carry out successful cleaning it is important first to identify:

- each element of the structure, and the type of material to be cleaned;
- the general condition of each material;
- the type(s) of soiling in each area;
- any special conditions. These should be noted on drawings and in the specification;
- the nature of adjacent materials and their ability to cope with the proposed cleaning system.

These items must be clearly identified and specified beforehand and not left to the knowledge and resources of the cleaning contractor.

Experience teaches us not to underestimate the impact of cleaning on buildings.

CLEANING DETERIORATED STONES

When dealing with delicate, friable or deteriorated stonework, special precautions should be taken and cleaning carried out only if unavoidable. The amount of water used in washing should be strictly controlled (e.g. by applying sensors to the surface of the stone).

Poultices can be successfully used to clean delicate stonework.

Some deteriorated stone surfaces are so weak that the application of any cleaning process would result in the loss of large amounts of material. In this instance the surface can be temporarily consolidated first and then cleaned. This applies in particular to 'high value' surfaces such as sculptures or precious detailing. This type of work has to be carried out by a specialist in the field. For more information on this system consult the publication by Giorgio Torracco Porous Building Materials listed in the Further reading section.



ABOVE: Government House, Perth

SAFETY AND PROTECTION OF THE ENVIRONMENT

Many cleaning processes are unpleasant for the operator and some are dangerous.

Observance of safety precautions is essential.

Areas in close proximity (including vegetation), must be protected from the effects of chemicals, dust, residues, water cleaning action and overspray.

Adequate first aid provisions should be at hand and all workers must be protected from the effects of dust and chemicals by wearing adequate and approved protective equipment at all times during the cleaning operations.

When surfaces are being cleaned with chemicals, scaffold tubes should have their ends sealed before use. All scaffolding components should be thoroughly washed during dismantling. Care should be taken to ensure the waste water or liquids are contained and safely removed from site.

All items related to protection and safety should be extensively detailed in the job specifications.

Toxic waste must be disposed of correctly.

After cleaning

Cleaning may reveal defects and the program should allow for unexpected repairs.

After completion of all work, the window glass should be washed. Stained and painted glass should not be rubbed.

If efflorescence appears after cleaning the salts should be allowed to crystallize and brushed off when dry. Poultices may be applied if necessary.

CLEANING EFFLORESCENCE FROM MASONRY

Removal of salts

The cause of the efflorescence should be identified and remedial action taken before cleaning.

Crystallisation of soluble salts will set up sufficient forces to cause serious damage to the masonry. The damage may take the form of exfoliation, spalling or fretting.

In lower temperatures evaporation is from the surface and the salts, carried through the stone in solution, are deposited on the face of the stone in the form of efflorescence. In such cases the decay is less dramatic but the face of the stone may still be corroded by the salts, which should be brushed off when dry.

The application of wet poultices may be of limited usefulness. Applications must be repeated as many times as needed to remove the salts completely. Otherwise the poultices may only remove the salts close to the surface.

A common means of removing efflorescence from masonry is washing with steam vapour and water, but this may have the shortcoming of forcing the dissolved salts further into the masonry while only partially removing the salts from the surface.

A technique which combines washing with suction of water from the surface of the wall with a vacuum pump seems to give the best results.

Removal of organic growth

Organic growth may be algae, fungi, lichens (symbiotic growth of algae with some types of fungi) or mosses.

Some of these growths have a more destructive effect on stone than others, but all these forms of vegetation encourage water retention and should be removed.

When wet, most of these growths can be easily detached from the masonry surface with a wooden or rubber scraper. The wall may then be washed and gently brushed with a bristle brush to remove stubborn growth (such as lichens).

An application of an inhibitor such as quaternary ammonium compound could follow to prevent future growth.

Lichens are the most difficult to eradicate and substances which could be used may have a detrimental effect on the stone.

REMOVAL OF STAINS

This is a complex process and should be undertaken by a specialist.

Staining on masonry may be caused by a number of elements such as metals (iron, copper and bronze) asphalt, smoke, oil, bird droppings, organic growth etc.

For localised staining most cleaning agents can be applied in the form of a poultice, using an inert fill such as bentonite (Fuller's Earth), powdered chalk or sepiolite clay.

Each stain can be best or most satisfactorily cleaned with a specific medium for the particular element. Most of the publications listed in Further reading provide tables which specify the correct treatments for most types of stains.

HOW MUCH TO CLEAN OR DO NOT OVERCLEAN

The aim of conservation in general is not to make old buildings look 'brand new'. Although old buildings benefit aesthetically from cleaning during conservation work, and cleaning in general may re-expose valuable details and textures, overcleaning must be avoided.

Overcleaning will usually destroy the natural protective patina of the masonry and hasten its deterioration. An excessive use of cleaning agents, even plain water, may dissolve limestone and marble or penetrate the structure causing damage.

MASONRY COATINGS

There are two types: waterproof coatings and water-repellent coatings.

Waterproof coatings

These seal the surface against liquid water and water vapour and are usually opaque (bituminous coatings and some paints).

Waterproof coatings have an unacceptable effect on the appearance of masonry surfaces and should never be used.

Water-repellent coatings

These prevent liquid water from penetrating the surface but allow water vapour to enter and leave through the masonry. They are usually transparent, but change the reflective property of the masonry and affect its overall appearance. This type includes the silicone-based coatings found currently on the market.

Coatings can keep out wind-driven rain, but cannot stop other types of water penetration.

Those coatings which permit water evaporation, will in fact move the evaporation from the surface to the layer within the masonry corresponding to the depth of penetration of the coating.

The crystallisation of soluble salts will build up a pressure behind the coating which will eventually cause exfoliation and loss of the surface. Coating masonry with water-repellent therefore can be not only ineffective but damaging to the masonry itself.

Where rising damp is present, the use of coatings will drive the moisture higher up the wall.

These coatings have relatively short life (because of the deterioration from ultraviolet light) and may develop in a rather patchy appearance. The coating must usually be re-applied within five to ten years. As the masonry needs to be cleaned before a new coat is applied the costs of maintenance are increased correspondingly.

Errors of application can leave unsightly streaks and variations in surface gloss across the masonry. These coatings must be used only to solve specific problems in limited areas and then only when there is no better alternative.

Further reading

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