

Code of practice for

# Cleaning and surface repair of buildings —

**Part 1: Natural stone, cast stone and  
clay and calcium silicate brick masonry**

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| Department of the Environment (Building Research Establishment)           | Society for Protection of Ancient Buildings |
| Department of the Environment (Department of Transport — Common Services) | Stone Federation                            |
| Ecclesiastical Architects and Surveyors' Association                      | Coopted members                             |

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## Foreword

This code of practice has been prepared under the direction of the Elements and Components (of Diverse Materials) for Buildings Standards Committee. It is intended to give building owners, architects, surveyors, engineers and contractors general background information when considering cleaning and surface repairs<sup>1)</sup>.

Part 1 of BS 6270 covers natural stone, cast stone and clay and calcium silicate brick masonry, including the special materials terracotta and faience. It describes the main methods in common use and draws attention to some of the problems encountered in practice. However, in view of the widely differing ages, materials and locations of masonry buildings, only general guidance is given to enable the user to select the most appropriate method for the particular building concerned.

Some experimental treatments for consolidation and preservation of masonry are described in Appendix D. These treatments should be used only after consultation with specialists in conservation.

Although some use has been made of glass reinforced cement and glass reinforced plastics for repairs, insufficient evidence of satisfactory use is available at present to include these materials in this code.

Where the code recommends seeking specialist advice, information may be obtained from organizations represented on the committee (see the cooperating organizations on the Inside front cover). This may include advice on finding materials for surface repairs, including suitable replacements for old bricks and stone.

In particular, attention is drawn to the following regulations applying to cleaning and surface repair work:

Construction (General Provisions) Regulations 1961 Factories Act 1961.

Health and Safety at Work etc. Act 1974.

Abrasive Wheels Regulations 1970.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

**This code of practice represents a standard of good practice and takes the form of recommendations. Compliance with a British Standard does not of itself confer immunity from legal obligations.**

### Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 38, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

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<sup>1)</sup> The term “surface repairs” has been used throughout in place of the term “restoration” to make it clear that the work may not restore the original material, surface or construction.

## Section 1. General

### 1 Scope

This Part of BS 6270 makes recommendations for the cleaning and surface repair of masonry constructed of natural stone, cast stone (artificial stone) and/or clay or calcium silicate bricks, including terracotta and faience (see Appendix G).

Where work on features of artistic or historic importance is being considered, guidance from specialists should be sought, since the general recommendations made in this code may need to be supplemented.

Structural repairs are not covered by this code.

For guidance, reference should be made to the following standards:

BS 5390, *Code of practice for stone masonry*.

BS 5628, *Code of practice for use of masonry*.

### 2 References

The titles of the publications referred to in this code are listed on the inside back cover.

NOTE See also Appendix F for a bibliography.

### 3 Definitions

For the purposes of this code the definitions given in BS 6100-1 and BS 6100-5 or in the British Standard for the given material or component apply.

Additional definitions relating to terracotta and faience are given in Appendix G.

NOTE The terms “mastic repair” and “plastic repair” both refer to repairs using special mortars. However, the former is used in connection with brickwork, whilst the latter is used in connection with stonework.

### 4 Preliminary considerations

#### 4.1 Reasons for cleaning

**4.1.1 Introduction.** It is convenient to classify reasons for cleaning under two headings: aesthetics and maintenance. In practice, cleaning a building for aesthetic reasons may reveal the need for maintenance.

**4.1.2 Aesthetics.** One or more of the following reasons may apply even where maintenance is not required:

- a) to reveal the nature, colour or details of an existing building;
- b) to unify the appearance of a building which has been altered, extended or repaired;
- c) to facilitate the choice of suitable materials for a proposed extension or for repairs;
- d) to reflect more light onto other buildings;
- e) to promote personal or civic pride.

**4.1.3 Maintenance.** It may prove necessary to clean the building for either of the following reasons:

- a) to remove harmful deposits from the fabric;
- b) to expose defects in order to establish the extent and nature of repairs needed.

#### 4.2 Reasons for surface repairs (including repointing)

**4.2.1 Introduction.** The reasons for undertaking surface repairs also may be classified under two headings: aesthetics and structural preservation.

**4.2.2 Aesthetics.** The only surface repairs undertaken solely for aesthetic reasons are those which have no particularly beneficial effect on the fabric, structure or weather resistance of the building. This includes such work as the repair of decayed or eroded ornamentation, statuary and surface decoration, or the removal and replacement of areas which have become permanently stained or been repaired inappropriately in the past.

**4.2.3 Structural preservation.** Most surface repairs which come within the scope of this code are concerned with the prevention of ingress of moisture and with the repair or replacement of elements which have suffered damage. In particular, one or more of the following considerations may apply:

- a) to restore the weather resistance of the building;
- b) to repair surface defects likely to affect, in the long term, the stability of the whole structure or of parts of the structure;
- c) to replace defective fixings, such as wrought iron cramps and ferrous metal components;
- d) to reinstate the surface of the building after structural repairs.

#### 4.3 Buildings of architectural or historic interest.

Where the building concerned is statutorily listed or in a conservation area, the local authority should be consulted. In some conservation areas, the local authority may discourage or even prohibit the cleaning of individual buildings, so as to conserve the uniform appearance of whole streets or areas.

Where work on features of historic or artistic importance is being considered, guidance from specialists should be sought, since the general recommendations given in this code may need to be supplemented.

Care should be taken not to remove traces of original design or colouring where these may be of architectural or historic interest.

**NOTE** Scheduled monument consent from the Secretary of State for the Environment is required before any works are carried out on a Scheduled Ancient Monument. Listed building consent from the local planning authority is required before any works are carried out for demolition of a listed building or for its alteration or extension in any manner which would affect its character as a building of special architectural or historic interest.

5 Choice of method

As there are many ways of cleaning and repairing buildings, and a wide range of buildings and materials is to be considered, it is not possible to recommend general methods to suit every case encountered in practice. Each project should be considered carefully in the light of all available methods and of previous experience with the building in question or other similar buildings. The method to be adopted should be agreed before tenders are invited.

In certain cases it may be advisable to clean a trial area using the proposed method.

It is essential to identify correctly all materials, both those being treated (see clause 10) and those to be removed (see clause 11). In particular, it is important to know whether a building stone is limestone or sandstone.

Any one building will display a variety of surfaces and sometimes a variety of materials. Each needs to be cleaned or repaired by an appropriate method, which might mean that more than one method needs to be used when cleaning or repairing the whole building. Where treatment of one material or surface may harm another adjacent material or surface, proper consideration and protection is essential, e.g. glass is damaged by hydrofluoric acid (HF).

Given the relative cost of different methods, the choice of method should take into account all the factors listed in Table 1.

6 Services

Before choosing a method, it is necessary to ascertain which of the services listed below are adequate and in working order:

- a) water supply;
- b) drainage (see 8.2);
- c) electricity.

In general, cleaning and surface repair work may be carried out using clean tap water (potable water). However, it is advisable to use de-ionized water on delicate work.

7 Means of access to work

**7.1 Scaffolds.** Usually, scaffolding can be erected to reach all parts of buildings. For repairs, independent scaffolds may be required (see 14.1). For guidance, see BS 5973.

In some cases permanently installed suspended access equipment is used. For guidance, see BS 6037.

To avoid rust staining of the building, unprotected steel scaffolding should not be used.

Where scaffold transoms are tight against the building surface, the ends should be capped.

Great care should be taken when erecting and dismantling scaffolds to avoid damage to property. The parts of the building masked by scaffold tubes should be cleaned separately.

Table 1 — Summary of factors affecting choice of method

| Factor to be considered                                                                                                                                                        | Remarks                          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| 1. Type and condition of surface                                                                                                                                               | Includes extent of ornamentation |
| 2. Type and condition of material                                                                                                                                              | See clause 10                    |
| 3. Amount and type of deposits to be removed                                                                                                                                   | See clause 11                    |
| 4. Type and use of building                                                                                                                                                    | See notes 1 and 2                |
| 5. Location of building                                                                                                                                                        | See notes 1, 3 and 4             |
| 6. Availability of services                                                                                                                                                    | See clause 6                     |
| 7. Disturbance to public: dirt, dust, noise, chemicals                                                                                                                         | See clause 9                     |
| 8. Speed of work                                                                                                                                                               | See Table 2                      |
| 9. Likely weather conditions                                                                                                                                                   | See 8.5 and note 1               |
| 10. Interior work                                                                                                                                                              | See 8.1                          |
| NOTE 1 The height of a building and its relationship to public ways may make the use of abrasion or chemicals a hazard, particularly in very windy conditions. (See clause 9.) |                                  |
| NOTE 2 Buildings of architectural or historic interest require special consideration. (See 4.3.)                                                                               |                                  |
| NOTE 3 The type of environment may be significant, e.g. industrial or marine.                                                                                                  |                                  |
| NOTE 4 The nature and condition of adjoining buildings also may influence the extent and method of work.                                                                       |                                  |

For safety precautions when using scaffolding, see 9.3.2 e) and f).

**7.2 Mobile towers.** Mobile towers may be used for cleaning and repairing buildings, where practicable.

**7.3 Cradles.** Where their use is practicable, cradles or electrically operated platforms are usually cheaper than scaffolding. For guidance, see BS 5974. The use of cradles for chemical cleaning is not generally good practice. [See 9.3.2 g).]

**7.4 Hydraulic work platforms.** Hydraulic work platforms are expensive but are particularly useful for operations of short duration.

## 8 Protection of buildings

**8.1 General.** Before any cleaning or surface repair work is begun, it is necessary to consider what protection or temporary support the building will require. The following are the principal points to be considered.

- a) Before cleaning, it is essential to seal temporarily any fractures and similar structural defects and to protect joints in order to prevent entry of cleaning agents.
- b) External fixtures, such as illuminated signs or name-plates, should be protected or, preferably, removed and stored for subsequent replacement, unless otherwise specified. The electricity supply to these fixtures should be disconnected.
- c) Decorative fixtures, such as balustrades, cornices and carved ornamentation, may need to be protected against damage.
- d) Where necessary, scaffold tubes should be capped (see 7.1).
- e) During the course of the work, debris should be collected from each lift of scaffolding and not swept off or thrown onto the ground, as this can damage other parts of the building.
- f) When cleaning interior surfaces, special precautions may be necessary to protect other parts of the structure, such as floors and woodwork, and the contents of the building, e.g. electronic equipment, monuments, organs, paintings.
- g) Stepboards should be used for access over glazing (see BS 5516).

**8.2 Water cleaning.** Usually the normal rainwater drainage system is adequate to take the amount of water used in cleaning the exterior of the building. However, before work is started, the system should be inspected to ensure that it is of adequate capacity and free from blockages.

Before starting work inside a building, particular consideration should be given to the disposal of waste water.

When using hot water<sup>2)</sup> pressure jetting, it is essential to consider protection against damage due to localized thermal stresses. Protection for glass and plastics panels and windows and paintwork should always be provided and hot water jets should not be allowed to impinge on plastics frames, guttering, pipes, etc.

NOTE Run-down water will not normally cause distortion.

**8.3 Air or water abrasive cleaning.** Before starting air or water abrasive cleaning, all windows should be protected with a polyethylene coating, applied in accordance with the manufacturer's instructions, and also a rigid sheet material, e.g. hardboard, where necessary. Care should be taken when fixing or removing these protective materials.

Hopper heads, rain water gullies and outlets should be covered and protected from the accumulation of spent abrasive. Similarly, intake fans and air inlets should be protected.

Spent abrasive should be collected and cleared from the site at regular intervals.

**8.4 Chemical cleaning.** As products based on hydrofluoric acid (HF) affect glass and polished surfaces, such as marble and granite, such surfaces should be protected carefully with polyethylene sheeting or a peelable coating, applied in accordance with the manufacturer's instructions.

Care should be taken when fixing or removing protective materials.

Exposed metal should be protected when acid or alkaline cleaning agents are used. [For protection of scaffolding, see 9.3.2 f).]

Paintwork should be protected when alkaline cleaning agents are used.

**8.5 Weather conditions.** All wet methods of cleaning and surface repair, including repointing, should be suspended, or suitable protection provided, if there is a risk of the building fabric becoming frozen whilst saturated with water. However, dry cutting out in preparation for surface repairs may proceed.

## 9 Protection of workers and public

**9.1 General.** To ensure protection of the public, the area where work is being carried out should be close sheeted. In addition, protective barriers may be required to prevent people passing under or near the working area.

All electric cables and fittings likely to be affected by the work should be disconnected or suitably protected before any work is begun.

Apart from taking these and other safety precautions common to all construction work, special measures are necessary when using certain cleaning methods, which are dealt with in 9.2 to 9.4.

<sup>2)</sup> For the purposes of this code hot water used for cleaning is taken to be water at a minimum jet temperature of 150°C.

## 9.2 Air and water abrasive (grit blasting) processes

**9.2.1 Protection of workers.** To safeguard workers, the following precautions should be taken during air and water abrasive cleaning.

- a) The use of abrasive materials containing free silica, such as flint and sand, should be avoided, as this can create health hazards (see 12.6.1).
- b) When using an air pressure gun suitable protective clothing, including an air-line helmet, should be worn.
- c) The air-line helmet should be supplied with clean air at a positive pressure, to prevent ingress of dust, preferably using an in-line air filter.
- d) Compressors, pipes and air lines, including couplings, connectors, etc., should be inspected regularly and tested.
- e) All air lines and pipes should be attached securely to the scaffolding on which work is in progress, bearing in mind the recoil of the gun due to the air or water pressure.
- f) The gun should be fitted with a “deadman’s handle”.
- g) Scaffold boards should be cleared regularly of debris and dust, as described in 8.1 e).

**9.2.2 Protection of public.** Noise levels should be kept to a minimum. For further guidance, see BS 5228-1 and BS 5228-2. Careful consideration should be given to the siting of compressors; in some cases, it may be desirable to move the compressor into a different position each day. The acoustic covers on the machine should be kept closed and, where the degree of noise is critical, e.g. near hospitals, the compressor should be installed in an acoustic shelter.

## 9.3 Chemical cleaning

**9.3.1 General.** It is essential to take special precautions when using chemicals. Burns caused by agents based on hydrofluoric acid (HF) need specialist treatment (see Appendix A).

Before cleaning is started, the following steps should be taken.

- a) The owners and occupiers of all buildings likely to be affected should be informed.
- b) The whereabouts of the nearest hospital equipped to deal with chemical burns should be ascertained.
- c) The extent of health and environmental hazards, if any, should be assessed carefully, if necessary in consultation with the appropriate authorities.

**9.3.2 Protection of workers.** To safeguard workers, the following precautions should be taken.

- a) All dilution, mixing and preparation of chemicals should be carried out off site under controlled conditions.
- b) Chemicals should be transported to the site and to the workface in sealed containers, secured to avoid spilling and clearly labelled with durable labels showing the hazardous ingredients and appropriate first aid procedures.
- c) If there is likely to be any contact with chemicals, shields that fully protect the face and throat should be worn, and also protective clothing, including long gauntlets and rubber boots, which should be chemical-proof and waterproof. As an additional protection, barrier creams may be used.
- d) Chemicals should be applied carefully to the building face using brushes rather than sprays.
- e) All scaffolding should be close boarded and sheeted to protect all workers not actually engaged in the work from chemicals and spray generated by high pressure hose or water lance rinsing.
- f) The open ends of scaffold poles should be capped before beginning work. After work has finished, the inside as well as the outside of scaffold tubes should be washed thoroughly with clean water.

Scaffold tubes and fittings as well as scaffold boards should be hosed down thoroughly immediately after washing the chemical cleaning agent off the adjacent parts of the building.

All equipment, especially protective equipment, should be cleansed thoroughly after use and stored where it is not subject to contamination.

g) Nets and ropes should be protected from hot water, chemicals and fumes from chemicals. Where the use of suspended cradles is unavoidable, the hoist ropes and other equipment should be given regular checks to ensure that there has been no loss in strength due to chemical corrosion.

Natural fibre ropes should never be used, as chemicals not only attack such ropes but in some cases destroy them.

As a general rule, if acids or alkalis of any concentration are brought into contact with a man-made fibre rope, they should not be allowed to dry off and thus concentrate. The rope should be washed out well in cold water.

NOTE The resistance of polyester fibres to acids is good but their resistance to alkalis is only moderate. On the other hand, the resistance of polyamides (e.g. nylon materials) to alkalis is good but their resistance to acids is poor. The resistance of the polyolefines (e.g. polypropylene and polyethylene) to both acids and alkalis is good.

**9.3.3 Protection of public.** Chemical cleaning should not be allowed without adequate protection. No application or rinsing method should be allowed to give rise to fine droplets which could be wind-borne as mist.

Any dangerous chemicals left on site should be stored in securely locked premises.

**9.3.4 First aid.** Adequate supplies of clean water should be available for drenching spillage of solutions onto clothing or parts of the body. Eye irrigation bottles filled with clean water should be kept immediately to hand.

Where hydrofluoric acid (HF) is to be used, a supply of calcium gluconate gel and a copy of Label 14<sup>3)</sup> should be included in first aid boxes on site.

Operators should be made aware of the precise type of chemicals being used so that they may advise doctors or hospital staff treating any injuries. Some suitable first aid treatments are described in Appendix A.

**9.4 Mechanical cleaning.** Abrasive wheels should be used only by a trained operator, wearing suitable protective clothing and eye protectors.

**9.5 Hot water pressure jetting.** When using hot water pressure jetting, complete body protection is essential to prevent burns and scalds. The recommendations for using plastics nets and ropes given in 9.3.2 g) should be followed.

## Section 2. Cleaning

### 10 Materials to be cleaned

#### 10.1 Stonework

**10.1.1 Limestone.** Limestone may be cleaned using any of the water cleaning methods (see 12.3, 12.4 and 12.5). In some cases, the water brings a brown stain to the surface of certain limestones, such as Portland. There is little that can be done to remedy this staining, which is caused by water-soluble tars. However, generally it fades with time, particularly when exposed to strong sunlight.

Air abrasion (see 12.6) is advocated sometimes to prevent staining but, in practice, the same discoloration is likely to appear after a time, as a result of exposure to rain. Generally speaking, dry or wet air abrasion may be used to clean the harder limestones but should not be used on softer stones.

Alkaline chemical cleaners should be used only in exceptional circumstances. (See 12.9.)

**10.1.2 Marble.** Marble may be washed with clean cold water (see clause 6) in the same way as limestone (see 10.1.1) if the soiling is water-soluble, sooty material. The quantity of water should be kept to a minimum. On small areas it may be convenient to soften the dirt by hand spraying and by applications of wet absorbent material, such as attapulgite or sepiolite clay or talc, trowelled on to the surface and secured with bandages of scrim. When the clay or talc is lifted, light scrubbing with a stiff nylon or bristle brush and further hand spraying may be sufficient to release the softened dirt. Valuable pieces should be cleaned with applications of absorbent material and de-ionized water, and the loosened dirt removed with cotton wool swabs.

Marble is frequently stained by metallic stains, oil and grease. Washing or poulticing with water will not improve the appearance and it may not be possible to remove the stains completely, particularly if they have been there a long time. The appropriate methods are described in 12.10.

**10.1.3 Alabaster.** The variety of gypsum known as alabaster has been used for monuments, statuary and internal decorative work. The cleaning of historic monuments is highly specialized work and fails outside the scope of this code. Other alabaster may be cleaned and treated as follows to remove dirt deposits and to improve the colour and lustre.

Running water should never be used to clean alabaster, since this stone is water soluble. Water may be used, mixed with attapulgite clay or sepiolite clay, to form an absorbent poultice, which should be applied carefully to the soiled surface with a small trowel or spatula in a thickness of approximately 12 mm. The poultice should be lifted at intervals of approximately 2 h to 3 h to observe progress on softening the dirt. The poultice application may need to be repeated two or three times.

Cleaning by rubbing gently with cotton wool swabs and water may be sufficient in many cases to improve the appearance, but stubborn dirt and grease will require swabbing with a suitable soap, such as a mixture of 10 % potassium methyl cyclohexyloleate soap in white spirit. Powder detergent should never be used. It is essential to use all liquids sparingly.

<sup>3)</sup> Obtainable from the Chemical Industries Association, 93 Albert Embankment, London SE1 7TU.

After removal of any cleaning agent with clean cotton wool and white spirit, and after the surface is dry, the alabaster may be treated with a thin application of cosmoloid/polyethylene wax and polished gently to remove all surplus wax and to protect and enhance the stone.

**10.1.4 Flint.** Flint may be cleaned with water in the same way as limestone (see 10.1.1). A hydrochloric acid (HCl) based agent may be used for cleaning the face of knapped flints after repointing.

Under no circumstances should hydrofluoric acid (HF) be used on knapped flints, because it whitens the faces of the flints.

**10.1.5 Sandstone and unpolished granite.**

Sandstone and unpolished granite may be cleaned using either abrasive methods (see 12.6 and 12.7) or chemical agents based on hydrofluoric acid (HF) (see 12.9). In certain cases, mechanical cleaning is useful (see 12.8).

Some wet methods of cleaning ferruginous sandstones can activate the iron content and cause staining. If a trial shows that such staining would be unacceptable, the risk of its appearance can be reduced, to a large extent, by either using a dry cleaning method (see 12.6.1 or 12.8) or by using a special wet cleaning method which will render the iron passive. The latter involves chemical cleaning (see 12.9) with an agent based upon hydrofluoric acid (HF) and orthophosphoric acid in the correct proportions.

**NOTE** When red sandstone is cleaned using acid-based agents containing phosphoric acid, encrustations can occur unpredictably. In some cases these may be 2 mm to 3 mm thick and adhere very strongly to the stone surface. As they are insoluble, they may take many years to weather away.

A method for cleaning red sandstone which can prevent the appearance of these encrustations uses a proprietary formulation in conjunction with hot water jetting. The formulation contains hydrofluoric acid and substances which convert any encrustations into soluble salts, and is very viscous. The viscosity of cleaning agent and the prewetting of the surface before application reduce the penetration of the chemicals into the sandstone and thus ensure that the cleaning action is confined to the surface. Hot water pressure jetting breaks down the gel and further increases the solubility of the salts formed so that they are removed from the masonry more effectively.

A similar technique can be used to remove any encrustations formed as a result of previous cleaning with agents containing phosphoric acid.

**10.1.6 Slate and polished granite.** Slate and polished granite require special treatment, as they cannot withstand normal cleaning methods. They should be washed with clean water and a mild detergent, and leathered off.

Once the polished surface of a granite has weathered away, the polish cannot be restored on site.

**10.1.7 Cast stone (artificial stone).** Cast stone may be cleaned using any the water cleaning methods (see 12.3, 12.4 and 12.5). However, the water sometimes produces a patchy effect after cleaning, where differential erosion of the surface has taken place.

Where water cleaning is ineffective, air abrasion (see 12.6) or treatment with chemical agents based on hydrochloric acid (HCl) (see 12.9) may be used.

Sometimes, the outer face of the stone is eroded so much that the inner core becomes exposed. In this case, cleaning will not improve the surface appearance.

## 10.2 Brickwork

**10.2.1 General.** Different techniques should be used for cleaning established and newly erected brickwork. For convenience, methods of cleaning established brickwork are given in 10.2.2, 10.2.3 and 10.2.4, whilst guidance on cleaning newly erected brickwork is given in Appendix E.

Abrasive and mechanical methods should be avoided except where other methods have proved unsatisfactory, e.g. when cleaning under projections.

Where brushing is needed to assist in the removal of dirt from soft carved or moulded brickwork, e.g. red rubbers, it should be carried out lightly, using only fibre brushes.

**10.2.2 Clay brickwork.** Cleaning clay brickwork can remove some or all of the surface, depending on the severity of the method used. This may have an unacceptable effect on durability and appearance. It should be noted that clay bricks may have a uniform colour throughout their body or they may have a different colour on the surface or a surface coating, e.g. sand faced bricks.

Where the binder of the material to be removed is organic, the use of neutral liquid detergents should be tried first. This applies particularly to heavy oil residues. If detergents are found to be ineffective, other chemical cleaning agents may prove more satisfactory. Whatever agent is chosen, the brickwork should, if necessary, be put into sound condition (see 14.3).

Water spray processes are seldom satisfactory when used on their own but may be used for cleaning very soft brickwork. Whilst there is always a risk of efflorescence when using "wet" methods, this can be minimized by ensuring that the brickwork never becomes saturated.

Some clay bricks contain soluble iron, manganese or vanadium<sup>4)</sup> salts. Depending on the age of the brickwork, iron, manganese or vanadium salts may still be active, and staining could result from wet methods of cleaning which saturate the brickwork. Therefore a trial area should be cleaned. If staining of this area occurs, a chemical analysis should be carried out to determine the nature of the stain and hence to select an appropriate method for cleaning the brickwork, e.g. an agent based upon hydrofluoric acid (HF) and orthophosphoric acid in the correct proportions has been found to be effective in treating iron stains.

Any efflorescent salts either should be allowed to weather away naturally or should be brushed off with a dry fibre brush.

**10.2.3 Calcium silicate (sandlime or flintlime) brickwork.** Calcium silicate brickwork may be cleaned by water spray, air abrasive, water abrasive or chemical methods. Although cleaning can remove some or all of the surface, this is not a problem in practice, owing to the uniform nature of the material. However, where chemical agents other than detergents are to be used, specialist advice should be sought.

**10.2.4 Glazed brickwork.** Soiling of glazed brickwork may occur either on the surface or under the glaze. Usually, surface soiling may be cleaned off using a water rinsable neutral liquid detergent. Where soiling exists behind the glaze, this is usually the result of dirt penetration through crazing of the glaze or, sometimes, the result of dirty water coming through the brickwork from behind the glaze. Such soiling cannot be removed. Any attempt to infiltrate a chemical through the glaze to clean from behind is almost certain to damage the glaze.

## 11 Deposits to be removed

**11.1 General.** The material to be removed will vary from a thin surface soiling to a depth of as much as 50 mm of material. Normally, it consists of airborne dirt, often bound together as well as to the masonry surface with either calcium sulphate or silica, depending on the substrate.

Typically, the former comes from the weathering of limestone or calcium silicate bricks and the latter from the weathering of sandstones or clay bricks.

Other materials commonly required to be removed are dealt with in 11.2 to 11.11.

It is important in every case to attempt to identify both the substrate and the material to be removed, since these are two of the factors that will determine the method of cleaning to be adopted (see Table 1). Toxic materials, such as old lead paint, have to be treated in such a manner as to satisfy the appropriate safety legislation.

A chemical analysis may be helpful in identifying the material to be removed.

**11.2 Calcium sulphate bound deposits.** Calcium sulphate bound deposits can usually be removed by one of the water cleaning methods (see 12.3 to 12.5). Air and water abrasion (see 12.6 and 12.7) may also be used on the harder substrates.

**11.3 Silica bound deposits.** Silica bound deposits can be removed using hydrofluoric acid (HF) based solutions (see 12.9), air or water abrasion (see 12.6 and 12.7) or mechanical cleaning (see 12.8).

**11.4 Cement splashes and calcium carbonate<sup>5)</sup> deposits.** Cement splashes and calcium carbonate deposits usually respond to treatment with a dilute hydrochloric acid (HCl) based solution (see 12.9). Particular care should be taken when treating limestone and other stones soluble in acid.

For removal of cement staining from newly erected brickwork, see Appendix E.

**11.5 Efflorescent salts.** Efflorescent salts should be removed from the fabric dry, using a fibre brush (see 12.2).

For removal of efflorescence from newly erected brickwork, see Appendix E.

**11.6 Bird fouling.** As much of the bird fouling matter as possible should be removed using a wooden scraper. Any remaining droppings adhering to the masonry may be wetted and left for about 1 h to saturate and soften, after which a high pressure water lance (see 12.4) may be used.

**11.7 Paint and graffiti.** Paint and graffiti are difficult to remove, as the pigment and medium often penetrate the pores of the substrate. Water rinsable paint removers complying with BS 3761:1970 preferably should be used. Alkali-based agents have been used successfully but the warnings in 12.9 should be heeded. After treatment with a paint remover or an alkali-based agent, a high pressure water lance, (see 12.4) should be used to remove any remaining resins and pigments.

Care should be taken not to remove traces of original paint or colouring.

<sup>4)</sup> Vanadium staining has been observed only in newly erected brickwork (see Appendix E).

<sup>5)</sup> Commonly known as "lime". In fact, lime consists of calcium oxide.

**NOTE** Various ways of removing graffiti are under study. Paint strippers are effective on some graffiti but can cause damage to the surface if not used in accordance with the instructions, and are limited in depth of penetration. Mixed solvents are of little value, giving hardly any penetration. A paste/solvent combination has been found to be effective on painted, tiled and other non-porous surfaces. However, when applied to low penetration graffiti on porous surfaces it can drive the stain further in and thus aggravate the problem.

**11.8 Coal tar and pitch.** Coal tar or pitch should be removed, as far as possible, by scraping. Then the surface should be scrubbed with organic solvent and an emulsifying agent and, if necessary, poulticed with the same solvent (see **12.10**), after which a high pressure water lance, using cold or hot water (see **12.4**) or steam cleaning (see **12.5**) should be used.

**NOTE 1** Removal of coal tar and pitch stains may be facilitated by cooling the area with ice or solid carbon dioxide to embrittle the deposit.

**NOTE 2** Attempts should be made to prevent spreading of the stain but this may prove impossible.

**11.9 Heavy and light oils.** Heavy and light oil stains should be scrubbed with water and an emulsifying or degreasing agent. White spirit should be used with care, since it evaporates slowly and can spread the stain further into the surface. Deeper stains will need poulticing with white spirit or trichloroethane followed by a high pressure water lance (see **12.4**) or steam cleaning (see **12.5**).

Deep stains may be lightened but may prove impossible to remove altogether.

For removal of oil stains from marble, see **12.10.4**.

**11.10 Organic growth.** Organic growth may be killed and removed dry with wooden scrapers and/or bristle brushes or may be removed using a high pressure water lance (see **12.4**). In all cases, the cleaned surface should be treated with a durable toxic wash (for further details see **16.4** and also BRE Digest No. 177 “Decay and conservation of stone masonry”<sup>6)</sup> and BRE Digest No. 139 “Control of lichens” moulds and similar growths”<sup>4)</sup>).

**11.11 Metallic stains.** Green stains caused by water run-off from cuprous metals can be removed sometimes by treatment with an ammonia solution poultice (see **12.10**). Several applications may be needed and even then the stains are liable to reappear. The masonry should be wetted with water before the ammonia is applied and should be washed down thoroughly afterwards.

Iron stains on unpolished granite, sandstone and clay bricks can be reduced or removed by the application of an agent based upon hydrofluoric acid (HF) and orthophosphoric acid in the correct proportions. Limestone, marble, polished granite, calcareous sandstone or calcium silicate brickwork should not be treated in this way, since these materials are attacked by the acid. However, it may be possible to bleach the stains with a solution of sodium dithionite. It should be emphasized that this treatment may leave salts in the fabric that could cause subsequent severe crystallization damage. It is, therefore, essential to wet the surface thoroughly with water before applying the chemical solution, and to wash down thoroughly afterwards.

For removal of metallic stains from marble, see **12.10**. For removal of manganese and vanadium stains from newly erected brickwork, see Appendix E.

**11.12 “Ghost staining”.** “Ghost staining” is a term used to describe two totally different phenomena. One is an apparent stain due to variable surface texture caused by differential erosion; this cannot be removed without refacing the masonry. The other is caused usually by penetration of water or other liquid, such as oil or bitumen, from behind the face, and seldom can be removed.

## 12 Cleaning methods

**12.1 General.** This clause describes the main methods of cleaning currently in use. Whilst it refers, in the main, to cleaning external surfaces of buildings, similar methods are used for cleaning internal surfaces, usually after vacuum cleaning. In the latter case, it is essential that the minimum amount of water or chemical should be used and that maximum protection is given to surrounding areas likely to be affected by the cleaning or effluent [see **8.1 f**].

Table 2 gives a summary of the relative costs and speeds and the advantages and disadvantages of the different methods. For guidance on choice of method, see clause **5**.

**12.2 Brushing.** Brushing may be used on its own, e.g. for removing efflorescent salts, using fibre brushes or, more commonly, in conjunction with water spray or chemical cleaning, using fibre or bronze brushes. Steel wire brushes should never be used, because broken particles from the wire can cause rust staining.

<sup>6)</sup> Obtainable from the Building Research Establishment, Garston, Watford WD2 7JR.

**12.3 Water spray.** Fine nebulous sprays of clean cold water are used to soften the dirt deposits, which are afterwards brushed off. In certain cases, it may be necessary to rub with a soft gritstone as well to remove heavier encrustations, taking care not to damage any original tool marks.

It is essential to use only enough water to keep the surface wet.

NOTE Various systems have been evolved which make use of specially designed jets to cover a wider area with the same amount of water.

For cleaning some areas, it may be advisable to use only a bucket of water and a brush, so as to minimize the amount of water used.

Care should be taken to prevent water ingress to interior finishes and fittings, e.g. plaster and timber [see 8.1 f)].

**12.4 High pressure water lance.** The high pressure water lance is a useful way of removing stubborn areas of dirt or organic growth, particularly when used in conjunction with water spray cleaning. The water pressure and type of nozzle should be adjusted to suit the fabric and its condition. Straight tip (pencil point) nozzles should never be used.

Hot or cold water may be used.

NOTE For the purpose of this code hot water used for cleaning is taken to be water at a minimum jet temperature of 80 °C.

The water lance is used also for rinsing off after wet air abrasion and chemical cleaning.

**12.5 Steam cleaning.** Steam cleaning is used rarely nowadays, not only because of the cost but also because the standard of cleaning achieved is not always satisfactory. However, when used in conjunction with suitable solvents<sup>7)</sup>, it is useful for removal of certain deposits, such as bitumastic paint, grease, oil and chewing gum.

## 12.6 Air abrasion

**12.6.1 Dry air abrasion (dry blasting).** Abrasives are blown at a suitable pressure on to the surface by means of a compressed air jet. The equipment comprises an air compressor and a pressurized storage pot, together with suitable hoses and specially designed nozzles.

The traditional abrasive materials used are sand and flint. However, these contain free silica, which can create a health hazard. Alternative materials, such as mineral slags, are available. It is essential to choose a grade and type of abrasive to suit the type and condition of surface to be cleaned.

Dry air abrasion should be used with caution, as it can cause damage to arrises, carved work, glazed brickwork and soft strata in masonry. In addition, silica dust from the surfaces being cleaned may be harmful to health.

**12.6.2 Wet air abrasion (wet blasting).** Similar to dry air abrasion (see 12.6.1), except that water is introduced into the air stream. It is necessary to remove any slurry left on the surface, using clean water. The main advantage over dry air abrasion is the reduction in the amount of dust and abrasive action.

**12.7 High pressure water abrasion.** Various systems are being introduced which add abrasive to a water jet to increase its abrasive action.

**12.8 Mechanical cleaning.** Spinning off with power tools, using carborundum discs to clean flat areas, removes dirt and the weathered face in a single operation. Great care should be exercised, since there is a considerable risk of damaging the surface, especially mouldings, and a potential health hazard from abraded silica dust.

In general, mechanical cleaning has been superseded by other methods.

## 12.9 Chemical cleaning

**12.9.1 Selection of chemical agent.** Great care should be taken to select the right chemical agent for cleaning a given type of material or surface (see Table 3). A considerable number of proprietary compounds is available. Where the composition is not disclosed, it is recommended strongly that discussions take place with the manufacturers before using such compounds to ensure that the compound is suitable for the particular application.

It is advisable to use liquid detergents to remove oil bound deposits before resorting to acid or alkali based agents.

In some cases, alkali based agents may be used to remove grease deposits before using acid based agents for the main cleaning operation. However, acid based agents should never be used before alkali based agents.

**12.9.2 Method of application.** The following method of application should always be used.

- a) Thoroughly wet the surface to be cleaned with clean water.
- b) Apply the chemical agent with a brush to the previously wetted surface.

<sup>7)</sup> See BRE Digest No. 177 "Decay and conservation of stone masonry", obtainable from the Building Research Establishment, Garston, Watford WD2 7JR.

c) After not less than 10 min, and normally not more than 30 min, thoroughly brush the surface and rinse off the chemical agent, using a high pressure water lance as described in 12.4. This is especially important for alkali based agents, as they can leave deposits of harmful salts, particularly in the joints.

The chemically treated surface should not be allowed to dry before rinsing. However, if this should occur accidentally it is better to make a fresh application rather than attempt to wash off the previous coat.

In some cases, it may be necessary to apply the chemical agent a second time to obtain a clean surface.

## 12.10 Poultice cleaning

**12.10.1 General.** Poultice treatments are used for drawing out stains, particularly on light coloured marble (see 12.10.2, 12.10.3 and 12.10.4). In many cases, so many applications are required to remove deep seated staining that this process is not an economic proposition. In all cases, specialist advice should be sought.

**12.10.2 Treatment of iron stains on marble.** To remove or lighten iron stains on marble, the following method should be used.

- a) Add a solution of one part sodium citrate and six parts water to an equal volume of glycerin.
- b) Add attapulgitic clay<sup>8)</sup> to the solution until a smooth paste is formed.
- c) Apply the paste to the surface and leave until dry.
- d) Remove the paste with a wooden or other non-metallic spatula.
- e) Repeat c) and d) as often as required to lift or satisfactorily lighten the stain.
- f) Repolish the roughened surfaces where necessary with putty powder and chamois leather.
- g) Finish with a microcrystalline cosmolid/polyethylene wax to achieve a soft shine.

Very stubborn iron stains may require an alternative treatment using sodium dithionite in a wet absorbent material such as attapulgitic or sepiolite clay<sup>4)</sup>. When using this treatment, the marble should first be wetted with a solution of one part sodium citrate and six parts water and subsequently rinsed off thoroughly with clean water.

**12.10.3 Treatment of cuprous metal stains on marble.** To remove or lighten cuprous metal stains on marble, the following method should be used.

- a) Mix dry one part of ammonium chloride with four parts powdered talc or attapulgitic or sepiolite clay. Add a 10 % solution of ammonia water.
- b) Pre-wet the marble with clean water, apply the paste to the surface and leave until dry.
- c) Remove the paste with a wooden or other non-metallic spatula.
- d) Rinse thoroughly with clean water.
- e) Repeat b), c) and d) as often as required to lift or satisfactorily lighten the stain.
- f) Repolish the roughened surfaces where necessary with putty powder and chamois leather.
- g) Finish with a microcrystalline cosmolid/polyethylene wax to achieve a soft shine.

**12.10.4 Treatment of oil stains on marble.** To remove or lighten oil stains on marble, the following method should be used.

- a) Mix one part of acetone and one part of amyl acetate.
- b) Soak a non-dyed cotton flannel in the solution and place over the stain to form a pack.
- c) Keep the flannel on the stained surface for three days under a thin film of polyethylene.
- d) Remove the flannel and thoroughly rinse the marble with clean water.
- e) Repeat b) to d) as often as required to lift or satisfactorily lighten the stain.
- f) Repolish the roughened surfaces where necessary with putty powder and chamois leather.
- g) Finish with a microcrystalline cosmolid/polyethylene wax to achieve a soft shine.

<sup>8)</sup> Traditionally, whiting (crushed chalk) was used.