

**BS 8221-1:2012**

*Incorporating corrigendum No. 1*



**BSI Standards Publication**

# **Code of practice for cleaning and surface repair of buildings –**

**Part 1: Cleaning of natural stone,  
brick, terracotta and concrete**

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### Summary of pages

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## Foreword

### Publishing information

This part of BS 8221 is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 31 July 2012. It was prepared by Technical Committee B/560, *Conservation of tangible cultural heritage*. A list of organizations represented on this committee can be obtained on request to its secretary.

### Information about this document

The start and finish of text introduced or altered by Corrigendum(a) No. 1 (and No. 2) is indicated in the text by tags **[C1]** and **[C1]**.

### Supersession

**[C1]** This part of BS 8221 supersedes BS 8221-1:2000, which is withdrawn. **[C1]**

### Hazard warnings

WARNING. This British Standard calls for the use of substances and/or procedures that can be injurious to health if adequate precautions are not taken. It refers only to technical suitability and does not absolve the user from legal obligations relating to health and safety at any stage.

### Use of this document

As a code of practice, this part of BS 8221 takes the form of guidance and recommendations. It should not be quoted as if it were a specification and particular care should be taken to ensure that claims of compliance are not misleading.

Any user claiming compliance with this part of BS 8221 is expected to be able to justify any course of action that deviates from its recommendations.

### Presentational conventions

The provisions in this standard are presented in roman (i.e. upright) type. Its recommendations are expressed in sentences in which the principal auxiliary verb is “should”.

*Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.*

### Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

**Compliance with a British Standard cannot confer immunity from legal obligations.**

## Introduction

This British Standard is intended to give building owners, architects, surveyors, engineers, and contractors general information on cleaning.

Buildings are cleaned either to enhance their appearance or to assist maintenance and/or conservation.

Reasons for wanting to enhance appearance include:

- a) removal of disfigurements (e.g. stains, graffiti); revealing the nature, colour or details of a building; and
- b) unification of the appearance of a building that has been altered, extended or repaired.

Reasons for cleaning a building prior to maintenance and/or conservation include:

- 1) removal of harmful or undesirable deposits or applied materials from the fabric in order to slow down the rate of decay;
- 2) exposure of concealed defects, where surfaces are very thickly soiled, in order to establish the extent and nature of repairs required;
- 3) preparation of a surface for additional treatments; and
- 4) to fulfil the terms of a lease that requires periodic cleaning of a building.

Buildings have a variety of surfaces and materials and types of soiling that each need to be cleaned with appropriate methods and materials. It is essential to identify, in advance, the type, properties, and condition of masonry (in particular, whether it is limestone or sandstone) and jointing materials.

## 1 Scope

This part of BS 8221 gives recommendations on the removal or partial removal of deposits from the original surface or substrate of a building.

It includes the principal cleaning methods in use and the characteristics of surface deposits. It is applicable to the cleaning of natural stones, clay brick, calcium silicate brick, glazed and unglazed terracotta/faience, and cast concrete and concrete products such as cast stone, concrete brick and concrete blockwork.

## 2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 1139-2 *Metal scaffolding – Part 2: Couplers – Aluminium couplers and special couplers in steel. Requirements and test method*

BS 1139-4 – *Metal scaffolding – Part 4: Specification for prefabricated steel splitheads and trestle*

BS 2482, *Specification for timber scaffold boards*

BS 6037 (all parts), *Code of practice for permanently installed suspended access equipment*

BS 6100-5, *Building and civil engineering – Vocabulary – Part 5: Civil engineering – Water engineering – environmental engineering and pipe lines*

BS 6100-6, *Building and civil engineering – Vocabulary – Part 6: Construction parts*

BS 8221-2, *Code of practice for cleaning and surface repair of buildings – Part 2: Surface repair of natural stones, brick and terracotta*

BS EN 39, *Loose steel tubes for tube and coupler scaffolds. Technical delivery conditions*

BS EN 1004, *Mobile access and working towers made of prefabricated elements. Materials, dimensions, design loads, safety and performance requirements*

BS EN 12811-1, *Temporary works equipment. Part 1: Scaffolds. Performance requirements and general design*

BS EN 15898, *Conservation of cultural property. Main general terms and definition*

### 3 Terms and definitions

For the purposes of this part of BS 8221, the terms and definitions given in BS 6100-5, BS 6100-6 and BS EN 15898 the following apply.

#### 3.1 faience

masonry, similar to terracotta, with some surfaces covered with a clear or coloured glaze

#### 3.2 fireskin

thin, smooth, outer layer on unglazed terracotta, containing a high proportion of fines

*NOTE In traditional firing processes, fireskin is vitrified to a greater degree than the body of the clay beneath. Fireskin is protective and retention of it is a priority in cleaning and repair works.*

#### 3.3 glaze

mixed paste of fluxes and colouring ingredients that, applied to a surface and fired, fuses with the open-pored underbody to form a thin, vitreous, transparent, or coloured coating of glassy, opaque or translucent consistency

*NOTE Glazes can be plain, mottled or textured and can range from high-gloss to egg-shell finish.*

#### 3.4 historic masonry

masonry that forms an integral part of a building or structure which is listed, scheduled or in a conservation area or is of acknowledged historic merit

#### 3.5 specialist contractor

contractor who has demonstrable expertise that is based upon knowledge and experience of best practice

#### 3.6 terracotta

fired-clay, fine textured and unglazed, usually yellow to brownish-red

### 4 Considerations affecting cleaning decisions

*COMMENTARY ON Clause 4*

*All cleaning operations present different criteria to consider, including a suitable method, the materials of construction, and their condition.*

#### 4.1 General

The following should be determined prior to carrying out a cleaning programme:

- a) the type and properties of masonry and jointing material;
- b) the condition of the masonry units and joints;
- c) the types, extent and nature of surface deposits;
- d) the susceptibility of substrates to various cleaning materials and processes;
- e) any effects that the cleaning methods and processes could have on the interior of the building; and
- f) the likelihood of any historic polychromy surviving beneath the soiling.

Information on current penetrating dampness problems or other problems caused by such dampness should be taken into account when deciding upon the cleaning method and processes.

Each project should be considered carefully, taking into account previous experience with the building (or similar buildings) and available materials and methods which might be useful but should not be assumed to apply fully.

If treatment of one material or surface could harm other materials or surfaces, these areas should be protected.

If features of artistic or historic importance are to be cleaned, specialist guidance should be sought.

Historic buildings sometimes have a conservation management plan, in which case the Conservation Policies contained therein should be followed. In the absence of a conservation management plan, the impact that cleaning and surface repair of the building has on the significance of the building should be understood and any detrimental consequences mitigated as appropriate.

Some deposits are not fully removable from surfaces without causing damage. Residual or uneven marks can remain, but should not be mistaken for poor quality cleaning.

Apart from cost, the factors listed in Table 1 should be taken into account prior to selecting a cleaning programme.

Where it is determined that surface repairs are required as part of the cleaning process these should be done in accordance with BS 8221-2.

Table 1 Factors affecting choice of cleaning method

| Factor                                     | Remarks                                                                                                                                                                                                                                                                                                        |
|--------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Type and condition of material             | Stonework (see Clause 5); clay and calcium silicate brickwork (see Clause 6); terracotta and faience (see Clause 7); and concrete (see Clause 8) should be identified                                                                                                                                          |
| Type and condition of surface              | Extent of deterioration, nature of joints, extent of ornamentation and other surfaces should be considered (see 4.2)                                                                                                                                                                                           |
| Amount and type of deposits                | See 4.3                                                                                                                                                                                                                                                                                                        |
| Construction                               | A) B)                                                                                                                                                                                                                                                                                                          |
| Type and use of building                   | C) D)                                                                                                                                                                                                                                                                                                          |
| Location of building                       | E) F) G) H) I)                                                                                                                                                                                                                                                                                                 |
| Health and safety risk assessment          | J) K)                                                                                                                                                                                                                                                                                                          |
| Environmental assessment                   | E) K)                                                                                                                                                                                                                                                                                                          |
| Availability of services                   | See 4.12                                                                                                                                                                                                                                                                                                       |
| Weather conditions                         | I)                                                                                                                                                                                                                                                                                                             |
| Interior work                              | Where possible an inspection of the interior of the building should be made and if necessary appropriate additional protective measures should be taken to contain the effect of cleaning processes                                                                                                            |
| Risk of re-soiling                         | Likelihood of re-soiling occurring and timescale for re-soiling should be taken into account.                                                                                                                                                                                                                  |
| Risk to other parts of the building fabric | Some methods pose greater risk to the building fabric than others, for example due to run-off of soiled water or chemical cleaning media, or water penetration into the fabric leading to corrosion of embedded metals, rotting of embedded timbers, salt mobilization or mobilization of iron-based minerals. |

A) Some buildings might contain embedded ferrous cramps or steel frame supports. These can require cleaning that restricts or eliminates water use.

B) Mortar in joints can entrap and be dissolved by cleaning chemicals, or can be eroded by abrasives.

C) Buildings of architectural or historic interest require special consideration and permission might be required to clean these.

D) The use or contents of a building can limit the cleaning process or add to preparatory and support measures.

E) The proximity of a building to vegetation and waterways and the position of the water table can prevent use of certain chemical agents. Biodegradable proprietary products should be used. Alternatively, special collection or containment measures might be required.

F) The height and position of a building can make water, abrasive or chemical use hazardous, particularly in very windy conditions.

G) The position, use and condition of adjoining buildings (especially listed buildings) can affect selection of a cleaning method.

H) Noise nuisance can restrict working methods or times.

I) Dust nuisance can affect selection of a cleaning method.

Table 1 Factors affecting choice of cleaning method

<sup>J)</sup> Health and safety considerations might restrict use of certain processes.

<sup>K)</sup> All lead-containing and other toxic debris, including masks and filters should be collected in plastic bags and sealed with tape.

*NOTE 1 Attention is drawn to the Environmental Protection (Duty of Care) Regulations 1991 [1]. It is advisable to verify appropriate disposal routes with the local waste regulator.*

*NOTE 2 Consent to discharge waste water from chemical cleaning and from other wet processes might be required from the local authority or the local water authority.*

*NOTE 3 Where cleaning interiors are concerned any reports on decorative surfaces need to be sought prior to any decisions being made.*

## 4.2 Inspection and identification of substrate

A comprehensive survey should be carried out, in the presence of advisors with expertise in the type of building, prior to carrying out a cleaning programme. The nature and condition of substrate materials and the types of surface deposits should be assessed before an appropriate cleaning method is selected.

Building and structures to be cleaned should be inspected closely, using the following procedure.

- a) Each material should be identified in sufficient detail so that cleaning can proceed without risk to the fabric.
- b) The condition of the construction and its joints and associated materials should be assessed and recorded, as well as the effects of previous cleaning operations.
- c) The extent and nature of surface deposits should be identified (see 4.3).
- d) Tests to identify a substrate type for susceptibility to various cleaning processes and the effects of deposits should be carried out if appropriate.

*NOTE In some cases, it might be necessary to take samples of the substrate or soiling for laboratory testing, in order to accurately identify the materials.*

## 4.3 Identification of surface deposits

### COMMENTARY ON 4.3

*Deposits on external facades of buildings can vary from a few microns to as much as 50 mm in thickness and cleaning can involve removal of one or more of the following deposits:*

- a) *atmospheric particulates, often bound together as well as to the masonry surface with either calcium sulfate or silica, depending on the substrate;*
- b) *growths;*
- c) *mortar splashes and runs;*
- d) *encrustations of calcium carbonate from lime-rich masonry;*
- e) *efflorescent salts;*
- f) *bird fouling;*
- g) *paint and graffiti;*
- h) *bird-repellent gel;*
- i) *heavy and light oils;*
- j) *metallic stains; and*
- k) *previous treatments or reaction products derived from previous treatments.*

The layer of soiling and the altered surface of the substrate should be distinguished from each other at investigation stage, so that the level of cleaning (see Clause 9) can be selected.

#### 4.4 Documentation

Records should be kept of cleaning operations on buildings of significance, including:

- a) photographs of the building showing its condition and appearance before and after cleaning is carried out; and/or
- b) drawings of deposit patterns, thicknesses, the nature of deposits, and condition of masonry.

*NOTE 1 Photogrammetry or rectified photography may be used for complex cleaning programmes.*

Specifications and other documents that might be required for a cleaning project should be prepared in sufficient detail to give proper guidance in the preparation of estimates and the execution of the work. Copies of all relevant documents should be available to all parties involved, including site personnel responsible for supervision.

*NOTE 2 A cleaning project can involve several parties, including client, main contractor and subcontractors, suppliers and inspectors.*

*NOTE 3 General requirements in respect of cleaning specifications are described in 4.8.*

Documents should be retained to provide background information prior to further assessments or work.

#### 4.5 Selection of cleaning method

Following assessment of the substrate and soiling (see 4.2 and 4.3), an appropriate cleaning method should be selected (see Clause 10).

*NOTE A cleaning process may involve multiple applications of one system or several removal systems, with procedures specified in the main contract.*

Trials should be carried out so that a detailed cleaning procedure can be specified (see 4.6 and 4.7).

#### 4.6 Trial cleaning areas

A trial area should be cleaned to determine:

- a) the suitability of the cleaning method for the masonry, its condition, and the surface deposits; and
- b) the standard of cleaning that can be achieved, and its acceptability.

Cleaning processes should be pretested on materials, surfaces and deposits representative of the whole building. If possible, test areas should be located in unobtrusive locations. Test areas should be small in case it is decided not to clean.

When trialling different cleaning methods those which are least harmful should be tested first. Progression made towards methods which are more harmful should be made only if necessary in order to determine a cleaning method which is successful.

A detailed record should be kept of trial cleaning and the location of trial areas. This should be retained for reference throughout the duration of the cleaning contract.

Trial cleaning should be observed and assessed by persons responsible for preparing the cleaning specification. Trial areas should be available for inspection by relevant authorities.

If possible, trial cleaning should be agreed beforehand, and carried out by trained and experienced specialists conversant in a variety of cleaning systems.

#### 4.7 Assessment of trial areas

Trial areas should be assessed wet and dry.

Full assessment should include:

- a) potential damage to the fabric as a result of cleaning;
- b) colour changes resulting from the cleaning process;

*NOTE 1 It can take several weeks for colour changes to become apparent in some stones.*

*NOTE 2 A colorimeter may be used to make accurate colour comparison between test areas not immediately adjacent to each other, or at different points in time.*

- c) the probable appearance of the facade after cleaning;
- d) the probability and time span of deposits returning to the cleaned facade;
- e) an estimate of periodic recleaning operations and the effects of these on the building; and
- f) the efficacy of soil removal.

#### 4.8 Specification

##### COMMENTARY ON 4.8

*The prime functions of a specification for cleaning a building are as follows:*

- a) *to describe the substrates to be treated and the means by which the required finish is to be achieved. Means includes materials, systems, application methods and the conditions under which the work is to be done;*
- b) *to provide a basis for accurate pricing and tendering;*
- c) *to serve as a comprehensive reference document for all parties; and*
- d) *to act as a reference if disputes arise or arbitration is necessary.*

After an assessment has been carried out and documented, a detailed specification for the work should be prepared. Specifications for cleaning should be integrated with specifications for surface repair.

Specifications should be clear, concise and unambiguous.

*NOTE 1 Certain aspects of repair work relating to prevention of water penetration might be required prior to cleaning.*

*NOTE 2 Aspects to which special attention is to be given in the preparation of specifications for cleaning buildings are described in 4.9 to 4.15.3.*

#### 4.9 Selection of a specialist contractor

Cleaning should be undertaken by specialist contractors. The competency of the contractor and the skilled operatives assigned to carry out proposed work should be established. Works supervisors should have a full working knowledge of the materials and cleaning processes, as any cleaning method involves potential damage to the fabric of the building.

#### 4.10 Use of scaffolding

Scaffolding should be erected in accordance with BS EN 12811-1, BS 1139-2, BS EN 39, BS EN 1004, and BS 2482. If permanently installed suspended access equipment is used, guidance should be obtained from BS 6037 (all parts).

Means of access should be suitable for the cleaning operation. Particular attention should be paid to:

- a) tying-in to avoid or reduce damage to the faces of masonry units;
- b) the avoidance of physical damage during erection and striking;
- c) the use of base plates to isolate stones or other surfaces from scaffold standards;
- d) the avoidance of rust staining of the building and pavements; and
- e) capping pole ends if chemicals are used.

#### 4.11 Availability of services

Before choosing a cleaning method the environmental impact of the process should be evaluated. This should include the disposal of run offs, spent abrasive and other residues. The water supply, drainage, and electricity supply should be examined to ensure they are satisfactory.

*NOTE 1 Non-ferrous, non-corroding pipes, fittings, nozzles, booms, etc., might be required to avoid staining.*

Only mains quality water should be used. Water should not deposit or cause stains.

*NOTE 2 Quality of water is important. In some non-potable supplies, a high iron content can cause brown surface stains.*

#### 4.12 Weather conditions

If there is a risk of freezing of the building fabric, wet cleaning methods should be suspended, or suitable protection should be provided.

#### 4.13 Protection of buildings and surroundings

Protection and preliminary works requirements for the building should be considered prior to carrying out cleaning work.

Before cleaning, any fractures or open joints, including around windows, should be temporarily sealed to prevent entry of cleaning agents (non-staining, readily removable materials, such as foam rods, or temporary pointing, may be used). Repointing should be carried out if required.

Glazing and window frames should be protected with plastic and tape.

*NOTE More durable protection (e.g. purpose-made plywood sheets) might be required to protect stained glass.*

Electricity to external signs should be disconnected and external fittings (e.g. signs and nameplates) should be removed and stored, or protected in situ. Protection should be provided for street furniture, railings, signage, meters, vents, etc.

Decorative features (e.g. balustrades, cornices and carved ornamentation) should be protected.

Cleaning areas should be sheeted in. Other masonry materials should be protected within the cleaning area if applicable. Polished granite, limestone, marble, terracotta, and faience should be protected if chemicals are used to clean adjacent materials. Soft or brittle materials should be protected from adjacent abrasive cleaning.

If possible, cleaning should be from the upper parts of a structure downwards. In cases where this is not possible, cleaning should be carried out in a manner that ensures finished work is not affected.

*NOTE When cleaning building interiors, special precautions might be required to protect floors, plasterwork, woodwork, and building contents (e.g. electronic equipment, monuments, organs, paintings).*

Temporary catchments and gutters should be provided, if required, to remove large amounts of water from the building and to avoid over-saturation at lower levels.

Gullies and other rain water discharge inlets should be protected from blockage through debris arising from cleaning and repair.

## **4.14 Protection of building surfaces**

### **4.14.1 Water washing**

Before cleaning the exterior of a building, the building's rainwater drainage system should be inspected to ensure that it is of sufficient capacity, and free from blockages.

An inspection of the masonry surface should be made. Temporary pointing or filling of any cracks that would let cleaning liquids enter the wall or the building should be carried out prior to cleaning.

Before cleaning the interior of a building, the disposal of water, effluents and other used cleaning materials and the creation of dust, noise and fumes and the affects of increase in RH should be taken into account.

If hot water pressure rinsing is carried out (i.e. with a minimum jet temperature of 80 °C), it is essential to protect against damage caused by localized thermal stresses. Glass, plastics panels, windows, and paintwork should be protected. Hot water jets should not make contact with plastics frames, guttering, pipes, etc.

*NOTE Run-down water does not usually distort plastics frames, guttering, pipes, etc.*

Cast-off sheets should be installed to prevent unwanted saturation.

### **4.14.2 Mechanical cleaning**

Windows should be protected with polyethylene sheeting, applied in accordance with the manufacturer's instructions, and, if required, a rigid sheet material (e.g. hardboard) prior to air or water abrasive cleaning. Protective materials should be fixed and removed with care.

Hopper heads, rainwater gullies, intake fans, and outlets should be covered and protected from accumulation of abrasive.

Spent abrasive should be cleared from scaffolding each day, in a manner which does not create dust and from the site at regular intervals.

All lead-containing and other toxic debris, including masks and filters should be collected in plastic bags and sealed with tape.

*NOTE Attention is drawn to the Environmental Protection (Duty of Care) Regulations 1991 [1]. It is advisable to verify appropriate disposal routes with the local waste regulator.*

### **4.14.3 Chemical cleaning**

Marble, glass, polished surfaces (e.g. granite), and other incompatible surfaces should be protected during chemical cleaning.

Surfaces which are incompatible with chemicals used on other types of masonry should be protected from them e.g. limestones from hydrofluoric acid used on brickwork, granite or sandstone.

Pavings, shrubs, plants, tree roots, etc., should be protected if applicable.

Mechanical fixings for protective materials should be attached into joints rather than masonry units. Trials should be carried out to ensure that masking tape and rubberized coatings do not remove paint.

*NOTE Some masking tapes and most plastics peelable coatings are not suitable for use on plastics and PVC surfaces.*

Exposed metal should be protected if alkaline cleaning agents are used. Paintwork should be protected if acid, alkaline or solvent cleaning agents are used.

## 5 Stonework

### 5.1 General

#### *COMMENTARY ON 5.1*

*Stones are naturally formed materials composed of a wide range of minerals and have extremely diverse microstructures and fabrics. Variations in these can be found even within individual masonry units.*

When selecting a method of cleaning, the properties and condition of each stone type should be taken into account, together with the type of deposits (see 4.2 and 4.3).

*NOTE 1 All stones are porous and absorb water and chemical agents. Weathered and decayed surfaces are more susceptible to damage by all cleaning methods.*

*NOTE 2 The three geological groups of rocks and some examples of corresponding building materials are given in Table 2.*