

BS 8298-1:2010



BSI Standards Publication

# Code of practice for the design and installation of natural stone cladding and lining –

Part 1: General

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ISBN 978 0 580 53038 8

ICS 91.060.10

The following BSI references relate to the work on this standard:

Committee reference B/545

Draft for comment 07/19983222 DC

**Publication history**

First published December 2010

**Amendments issued since publication**

| Date | Text affected |
|------|---------------|
|------|---------------|

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### Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 44, an inside back cover and a back cover.



## Foreword

### Publishing information

This part of BS 8298 was published by BSI and came into effect on 31 December 2010. It was prepared by Technical Committee B/545, *Natural stone*. A list of organizations represented on this committee can be obtained on request to its secretary.

### Supersession

Together with BS 8298-2, BS 8298-3, BS 8298-4 and BS 8298-5<sup>1)</sup>, this part of BS 8298 supersedes BS 8298:1994, which is withdrawn.

### Relationship with other publications

BS 8298, *Code of practice for the design and installation of natural stone cladding and lining*, will be issued in five parts:

- *Part 1: General;*
- *Part 2: Traditional handset external cladding;*
- *Part 3: Stone-faced pre-cast concrete cladding systems;*
- *Part 4: Rainscreen and stone on metal frame cladding systems;*
- *Part 5: Internal linings.*<sup>1)</sup>

### Information about this document

Stone, in the form of thin slabs of modest dimensions, has been used for centuries as a decorative facing to backgrounds of stone and brickwork. With framed structures, where the loads are carried by the frame and not by the external walling, the materials or combinations of materials used to cover the structural framework are referred to as cladding.

Cladding, in the form described in BS 8298, requires care to ensure permanent fixing and water management. Adequate precautions have to be taken to provide for permanent and temporary movements of the structure due to shrinkage and elastic deformation under load. Movement due to temperature and other factors also has to be taken into account.

BS 8298 describes the provisions necessary for the cladding to perform its function satisfactorily. It gives the minimum standards required and the materials and methods most frequently used for stonework. This part deals with materials used for cladding including the fixings and sealants as well as the natural stone. Other methods are covered in other parts. The parts of BS 8298 have been updated to reflect general changes in the types of cladding used and, in particular, the types of fixing system.

**Assessed capability.** Users of this British Standard are advised to consider the desirability of quality system assessment and registration against the appropriate standard in the BS EN ISO 9000 series by an accredited third-party certification body.

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<sup>1)</sup> In preparation.

**Use of this document**

As a code of practice, this part of BS 8298 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 8298 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.**

# 1 Scope

This part of BS 8298 gives recommendations for the design, installation and maintenance of mechanically fixed facing units of natural stone as a cladding held to a structural background by metal fixings.

As the “General” part of the BS 8298 series, this standard covers aspects of the other parts of the series, i.e.:

- a) traditional handset external cladding;
- b) stone-faced pre-cast concrete cladding systems;
- c) rainscreen and stone on metal frame cladding systems; and
- d) internal linings.

*NOTE 1 The terms and definitions given apply to all parts of BS 8298.*

Recommendations are given regarding movement of the structure, which might occur for one or more reasons, so that such dimensional changes can be accommodated.

*NOTE 2 The general principles for cladding also apply to soffits and sloping surfaces.*

BS 8298 does not cover stone veneer composite panels or the use of stone cladding as permanent formwork to in-situ concrete.

# 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 6100-1, *Building and civil engineering – Vocabulary – Part 1: General terms*

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

BS 6398, *Specification for bitumen damp-proof courses for masonry*

BS 6515:1984, *Specification for polyethylene damp-proof courses for masonry*

BS 8221-1:2000, *Code of practice for cleaning and surface repair of buildings – Part 1: Cleaning of natural stones, brick, terracotta and concrete*

BS 8221-2:2000, *Code of practice for cleaning and surface repair of buildings – Part 2: Surface repair of natural stones, brick and terracotta*

BS 8298 (all parts), *Code of practice for the design and installation of natural stone cladding and lining*

BS EN 197-1, *Cement – Part 1: Composition, specifications and conformity criteria for common cements*

BS EN 413-1, *Masonry cement – Part 1: Composition, specifications and conformity criteria*

BS EN 459-1, *Building lime – Part 1: Definitions, specifications and conformity criteria*

- BS EN 485-1:2008+A1:2009, *Aluminium and aluminium alloys – Sheet, strip and plate – Technical conditions for inspection and delivery*
- BS EN 485-2:2008, *Aluminium and aluminium alloys – Sheet, strip and plate – Part 2: Mechanical properties*
- BS EN 934-3, *Admixtures for concrete, mortar and grout – Part 3: Admixtures for masonry mortar – Definitions, requirements, conformity and marking and labelling*
- BS EN 998-1, *Specification for mortar for masonry – Part 1: Rendering and plastering mortar*
- BS EN 1008, *Mixing water for concrete – Specification for sampling, testing and assessing the suitability of water, including water recovered from processes in the concrete industry, as mixing water for concrete*
- BS EN 1469:2004, *Natural stone products – Slabs for cladding – Requirements*
- BS EN 1936, *Natural stone test methods – Determination of real density and apparent density, and of total and open porosity*
- BS EN 1996-2, *Eurocode 6 – Design of masonry structures – Part 2: Design considerations, selection of materials and execution of masonry*
- BS EN 10088-1, *Stainless steels – Part 1: List of stainless steels*
- BS EN 10088-2, *Stainless steels – Part 2: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes*
- BS EN 10088-3, *Stainless steels – Part 3: Technical delivery conditions for semi-finished products, bars, rods, wire, sections and bright products of corrosion resisting steels for general purposes*
- BS EN 12371, *Natural stone test methods – Determination of frost resistance*
- BS EN 12407, *Natural stone test methods – Petrographic examination*
- BS EN 12440, *Natural stone – Denomination criteria*
- BS EN 12588:2006, *Lead and lead alloys – Rolled lead sheet for building purposes*
- BS EN 12600, *Eurocode 6 – Design of masonry structures – Part 2: Design considerations, selection of materials and execution of masonry*
- BS EN 12670, *Natural stone – Terminology*
- BS EN 12811-1, *Temporary works equipment – Part 1: Scaffolds – Performance requirements and general design*
- BS EN 12878, *Pigments for the colouring of building materials based on cement and/or lime – Specifications and methods of test*
- BS EN 13139, *Aggregates for mortar*
- BS EN 13161, *Natural stone test methods – Determination of flexural strength under constant moment*
- BS EN 13279-1, *Gypsum binders and gypsum plasters – Part 1: Definitions and requirements*
- BS EN 13364, *Natural stone test methods – Determination of the breaking load at dowel hole*
- BS EN 13373, *Natural stone test methods – Determination of geometric characteristics on units*

BS EN 13755, *Natural stone test methods – Determination of water absorption at atmospheric pressure*

BS EN 14019, *Curtain walling – Impact resistance – Performance requirements*

BS EN ISO 11600, *Building construction – Jointing products – Classification and requirements for sealants*

PD 6484:1979, *Commentary on corrosion at bimetallic contacts and its alleviation*

### 3 Terms and definitions

For the purposes of all parts of this British Standard, the terms and definitions given in BS 6100-1, BS 6100-6 and BS EN 12670 and the following apply.

#### 3.1 air barrier

layer of the construction that provides the primary resistance to the passage of air through the wall

*NOTE The air barrier is typically a part of the backing wall.*

#### 3.2 anchors

##### 3.2.1 anchor

fastener which is fixed directly into the stone panel or to a concrete/masonry backing wall

##### 3.2.2 expansion anchor

anchor that works by a process of mechanical expansion against the sides of the hole into which it is fixed

##### 3.2.3 undercut anchor

type of expansion anchor that is fitted into a flared or undercut hole

#### 3.3 backing panel

precast concrete panel to which a stone facing is attached

#### 3.4 backing wall

layer of the wall that provides the airtightness and watertightness of a rainscreen system

*NOTE The backing wall can be an integral part of the rainscreen system, or it can be part of the building to which a rainscreen is added.*

#### 3.5 back-up material

material placed in a joint cavity behind the sealant to control the depth of sealant without inhibiting joint movement

#### 3.6 bimetallic corrosion

corrosion caused by contact between dissimilar metals in the presence of an electrolyte, such as water

#### 3.7 bond breaker

material applied to the rear surface of a stone to prevent adherence to a subsequently applied material

#### 3.8 breather layer

layer of a construction that is designed to resist the passage of liquid water from one part of a construction to another, whilst permitting the passage of water vapour in either direction

- 3.9 bush hammer**  
percussion tool for roughening a surface, with square head with pyramidal percussion teeth or points
- 3.10 bush hammering machine**  
machine consisting of feed rolls and a overhanging beam, supporting a pneumatic hammer
- 3.11 cavity barrier**  
construction provided to close a concealed space against penetration of smoke or flame, or provided to restrict the movement of smoke or flame within such a space
- 3.12 cladding**  
external covering to a structure
- 3.13 claw chisel**  
percussion tool for roughening a surface, with the cutting end covered by several teeth of various size
- 3.14 dry zone**  
part of a rainscreen system that can always be assumed to be protected from rainfall, generally on the inside of the watertight layer
- 3.15 facing**  
layer of stone attached to a backing panel
- 3.16 fascia**  
plain horizontal surface  
*NOTE A fascia is normally situated over an opening.*
- 3.17 fire stop**  
barrier that is placed in a cavity to prevent the passage of flame from one part of the cavity to another  
*NOTE Fire stops are also known as fire cavity barriers.*
- 3.18 fixings**
- 3.18.1 fixing**  
combination of bracket and fastener/anchors
- 3.18.2 cladding fixing**  
device to support or tie back cladding units to the structure
- 3.18.3 cladding restraint fixing**  
device to restrain or tie back cladding units to the structure  
*NOTE The term "tying back fixing" is deprecated.*
- 3.18.4 cleat**  
small bracket or fixture that is used to connect two parts of a metal framing system together
- 3.18.5 face fixing**  
cladding fixing through the exposed face of the stone which combines the function of a loadbearing and/or restraint fixing
- 3.18.6 fastener**  
screw, bolt, rivet or other component used to secure two or more components together, typically as part of a framing or bracket system

**3.18.7 fixing bracket**

discrete component used as an intermediate connector to join two other components together

*NOTE A fixing bracket typically allows for construction tolerances and different orientations of the components to be joined.*

**3.18.8 grommet**

collar around a pin to allow local flexing

**3.18.9 loadbearing fixing**

fixing which is intended to support the weight (dead load) of the object being fixed, as well as any other applied (live) loads

**3.18.10 combined loadbearing restraint fixing**

device that transfers the self weight of one or more cladding units to the structure and provides some restraint

**3.18.11 pin**

stainless steel pin fixed into the stone and into the backing panel

**3.18.12 soffit fixing**

device that carries both its own weight and restraint of a natural stone surface that varies from horizontal to 75°

**3.18.13 stone fixing**

fixing device to attach stone facing onto a backing panel

*NOTE Such fixings are generally dual purpose, providing both support and restraint.*

**3.19 gasket**

pre-formed rubber component that is used to seal a joint

**3.20 handset cladding**

stone panels seated one upon another, supported at defined levels on loadbearing angles and fixed directly to the structure with each stone unit secured with restraint fixings

**3.21 joints****3.21.1 baffle**

component that is either inserted into the joint or placed immediately behind the joint to prevent the direct passage of water through the joint

*NOTE A baffle can be formed by the simple expedient of stepping the panel edges so that they overlap. If it is not possible to see through the joint into the cavity behind then the joint is baffled. A loose fit of the baffle as a separate compartment allows the passage of air.*

**3.21.2 baffled joint**

open joint between two panels, or between a panel and an adjacent element of construction, which contains a simple baffle or other obstruction designed to prevent the direct passage of water through the joint

**3.21.3 compression joint**

joint designed specifically to accommodate pressure resulting from vertical shortening of the structure relative to the cladding

**3.21.4 dry butt joint**

joint in which units abut each other without any jointing material

**3.21.5 filled joint**

joint that makes use of a jointing product to fill the gap between adjacent parts

**3.21.6 horizontal compression joint**

joint designed specifically to accommodate partial closure resulting from vertical shortening of the structure relative to the cladding

**3.21.7 labyrinth joint**

open joint between two panels, or between a panel and an adjacent element of construction, that contains a complex baffle designed to cause several changes of air flow direction

*NOTE The construction of the joint prevents the direct passage of water through the joint and also provides changes of direction in order to shed water droplets from the air flow through the joint.*

**3.21.8 movement joint**

joint that permits movement between adjacent parts

**3.21.9 narrow joint**

joint where the gap between two panels is less than 6 mm, but does not have any added sealing element, relying only on closeness of fit to control the passage of water

**3.21.10 open joint**

joint between two panels, or between a panel and an adjacent element of construction, not closed by any sealing element, thereby permitting the free passage of air through the joint

**3.21.11 sealed joint**

joint between two panels, or between a panel and an adjacent element of construction, which is sealed with a gasket, wet-applied sealant or some other material, to prevent the passage of air and water through the joint

**3.22 kerf**

slot cut into the edge of a panel for the purpose of introducing a fixing device

**3.23 mullion**

vertical metal framing member used to support a stone panel or panels, or to which transoms are fixed for the purpose of supporting a stone panel or panels

**3.24 overcladding**

panelled cladding system fixed over an existing wall construction

**3.25 pilaster**

pier or part of a column attached to a wall

**3.26 pointing**

cementitious material used to fill a joint between stones

**3.27 pressure-equalized rainscreen**

rainscreen whereby open joints between the panels are combined with compartmentation of the cavity behind the panels to generate pressure in the cavity

*NOTE 1 This reduces the pressure difference across the joints and reduces both the amount of water ingress through those joints and the windload on the cladding panels.*

*NOTE 2 The initial flow of air through the joints during the pressure equalization process can carry some fine water droplets through the joints, so drainage is needed.*

**3.28 sealant**

unformed flexible material applied in joints to prevent the passage of moisture, wind and dust

**3.29 smoke stop**

barrier that is placed in a cavity to prevent the passage of smoke from one part of the cavity to another

**3.30 soffit**

exposed horizontal or sloping (to maximum of 75°) under-surface of any form of construction works

**3.31 spigot**

component that is inserted into the ends of two hollow sections to align them for the purposes of joining

**3.32 stallriser**

upright part of a shop front between the pavement and window sill or a low cladding unit located below a ground floor window

**3.33 surfaces/finishes**

**3.33.1 bush hammered surface**

surface obtained by using a bush hammer or a bush hammering machine

**3.33.2 filled surface**

surface where natural voids in stone are filled with cements, shellac or other material

**3.33.3 flamed finish**

surface finish obtained by thermal treatment of the stone using a high temperature flame

**3.33.4 ground surface**

surface obtained by means of a grinding or polishing disk, which can be rough, medium, fine, matt or polished

*NOTE Different ground surface finishes are obtained by using grinding or polishing discs with varying grain sizes. A rough ground surface can be obtained by using a grain size of, e.g. F 60, a medium ground surface with F 120, a fine ground surface with F 220, a matt ground surface with F 400 and a polished ground surface with a polishing disc or felt.*

**3.33.5 machine tooled surface**

surface finish resulting from a mechanical surface treatment with tools or dressed finish clearly showing tool marks

**3.33.6 riven finish**

roughened surface finish produced by splitting stone along natural cleavage or bedding planes

**3.33.7 sand blasted finish**

matt surface finish resulting from the impact of sand or other abrasive grains expelled by a jet

**3.33.8 striated surface**

surface obtained by using a claw chisel or a ruling machine

**3.33.9 trimmed surface**

surface obtained by using pointed chisel and mallet or a grooving machine

**3.33.10 water jet stream finish**

mat textured surface finish, accomplished by exposing the surface to a steady jet of water under pressure

**3.34 testing****3.34.1 initial type testing**

tests undertaken prior to placing a product on the market

**3.34.2 production control testing**

tests undertaken to determine the consistency of stone during production

**3.35 transom**

horizontal metal framing member which is used to support a stone panel or panels

*NOTE A transom can be supported on mullions or fixed directly to a supporting structure.*

**3.36 vapour control layer**

layer of a construction that is designed to resist the passage of water vapour from one part of the construction to another, in either direction

**3.37 ventilated rainscreen**

system of cladding in which panels of sheet material are used to shield the majority of a wall from direct rainfall, combined with an air gap (cavity) and drainage system behind the panels

*NOTE 1 The drainage system is used to intercept and remove any water which penetrates the rainscreen. Some or all of the joints between the panels are deliberately left open in order to ventilate the cavity.*

*NOTE 2 The cavity can also incorporate an element of insulation, a vapour control layer and/or a breather layer.*

**3.37.1 wet zone**

part of the rainscreen system that can be assumed to be exposed to rainfall, either directly or as a result of water flowing through joints and gaps in the system

*NOTE It is usually possible to identify one layer of the construction as being the watertight layer. All parts of the construction outside this layer can be assumed to be in the wet zone.*

## 4 Exchange of information and time schedules

### 4.1 General

Information should be exchanged between designers, installers and suppliers to enable the work to be scheduled satisfactorily, an accurate price to be obtained, supply and production difficulties to be minimized and safe and practical site fixing to be achieved.

At the preliminary design stage, the stone(s) selected might still be unquarried, and possibly in a foreign country; consideration should therefore be given to the availability and suitability of the stone(s) and the time for their preparation and delivery to site, especially when large quantities of stone are needed.

## 4.2 Initial feasibility planning

Information on the following should be obtained at the feasibility planning stage:

- a) The total areas to be clad and their locations on the buildings.
- b) The aesthetic and/or visual effect needed (referenced to existing buildings) in terms of colour jointing pattern, surface finish, physical characteristics, durability etc. in order to shortlist suitable stones.
- c) The natural variations in colour, tone and markings that could occur in the selected stone(s). This should be established during a visit to the quarry.
- d) The limitation in face size and thickness of possible stones and their availability from a quarry and/or works.
- e) The function of the cladding and the height, location and type of structure to which it is to be fixed
- f) The location of fire stops.

A draft project programme should be drawn up showing the time for stone selection, testing regime, order, manufacture and site installation.

*NOTE This time might be significant for contracts with large quantities of stone and/or when the supply of stone is from a quarry overseas.*

Current performance information of the selected stone should be obtained.

## 4.3 Tender stage

### 4.3.1 Design and performance specification

Wherever possible, the following information should be obtained at the tender stage:

- a) The building site limitations regarding access, restrictions, the time of deliveries, storage, handling and distribution facilities.
- b) Any limitation on the sequence and duration of site fixing, or an invitation to present recommendations.
- c) Sufficiently explicit drawings to show the basic construction requirements, stone thicknesses, jointing (including movement joints) and any special stones or labours and the type of surface finish.
- d) The building tolerance(s) allowed in the structure, affecting the design width of cavity or overall stone dimensions.
- e) The geological name of the type(s) of stone and any demands on matching or selection, or limits on acceptable natural variations referenced back to individual control samples supplied by or viewed at the quarry.
- f) The type of jointing and pointing (taking into account the manufacturing tolerances and joint width).
- g) The type(s) of sealant to be used.
- h) Details of any insulation within cavities and the method to maintain the minimum clear cavity.
- i) The fixing system to be used, or design recommendations.

- j) Any requirements for the routine or special testing of components, before or after erection, or for sample areas or mock-up panels.
- k) The proposed cleaning and maintenance regime (e.g. whether cleaning cradles are to be used).
- l) The criteria for the acceptance or rejection of individual stones and fixings.
- m) The testing regime and selection of testing samples for the different varieties of stones to be tendered.

#### 4.3.2 Facilities and materials required on site

To prevent misunderstanding, particularly at the tender stage, it should be made clear whether the following will be provided and by whom:

- a) A tower, or mobile crane, or forklift for offloading, distributing and raising packed stone adjacent to fixing areas at each level, and elevation.
- b) If there is no crane, a suitable hoist to take packed stone, and forklift/pallet truck to place in and take out on to scaffold or structural slab at each level and elevation.
- c) A forklift/pallet truck, and level access for the lateral movement of packed stone on to scaffold at each level and elevation, where the hoist cannot be positioned adjacent to working areas.
- d) The location of safe storage areas, with firm level access, when stone cannot be directly offloaded and placed adjacent to working areas.
- e) The boarded working scaffold (in not more than 2.0 m lifts with three boards between nearest upright and face of cladding, and allowing unimpeded lateral distribution of stone).
- f) The props for temporary support of, for example, fascias and soffits.
- g) Any adaptation of the scaffold for head trees or step-up brackets.
- h) The loading platforms at each level, in number and spacing appropriate to site and performance requirements.
- i) The supply of ordinary Portland cement, clean grit sand for bedding and grouting fixings.
- j) The supply of any special coloured mix for bedding and pointing.
- k) Construction and marking of datum lines and levels at each level, and regularly across elevations.
- l) The electrical supply (110 V) and water supply to within 30 m of working areas at each level.
- m) The location for the provision of site accommodation/lock-up store, and installation of 240 V electrical supply.
- n) The provision of messing, toilet, medical and other welfare facilities.
- o) The protection of fixed stone from any likely physical damage or staining.
- p) The removal of debris, packing cases etc. from agreed collecting areas.