



BSI Standards Publication

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

Part 2: Traditional handset external cladding

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ISBN 978 0 580 55962 4

ICS 91.060.10

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

Committee reference B/545

Draft for comment 07/30140555 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 26, 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Together with BS 8298-1, BS 8298-3, BS 8298-4 and BS 8298-5¹⁾, this part of BS 8298 supersedes BS 8298:1994, which is withdrawn.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.*¹⁾

Information about this document

This is a full revision of the standard, and introduces the following principal changes:

- BS 8298 has been completely restructured by splitting it into five parts;
- the BS 8298 parts have been updated to reflect general changes in the fixings systems available to support natural stone cladding panels.

BS 8298-1 contains the terms and definitions for all the parts of BS 8298.

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.

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.

¹⁾ In preparation.

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] GREAT BRITAIN. Building Regulations 2000 (as amended). London: The Stationery Office.
- [2] SCOTLAND. The Building (Scotland) Regulations 2004. Edinburgh: The Stationery Office.

1 Scope

This part of BS 8298 gives recommendations for the design, installation and maintenance of traditional handset external cladding of natural stone held directly to a structural background by metal fixings.

It covers:

- a) the provisions necessary for the cladding to perform its function satisfactorily;
- b) the materials and methods most frequently used for stonework; and
- c) the use of thermal insulation behind external cladding.

Loadbearing cladding or cladding held only by adhesion is not included, nor is any type of cladding supported or held in position around the perimeter of stones or series of stones by metal framing.

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

This part of BS 8298 is to be read in conjunction with BS 8298-1. Different cladding and lining methods are covered in the other parts of BS 8298 (see Foreword).

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 5606, *Guide to accuracy in building*

BS 6093, *Design of joints and jointing in building construction – Guide*

BS 8298-1:2010, *Code of practice for the design and installation of natural stone cladding and lining – Part 1: General*

BS EN 1991 (all parts), *Eurocode 1 – Actions on structures*

BS EN 1991-1-4, *Eurocode 1 – Actions on structures – Part 1: General actions – Wind actions*

BS EN 12372, *Natural stone test methods – Determination of flexural strength under concentrated load*

BS EN 13161, *Natural stone test methods – Determination of flexural strength under constant moment*

BS EN 13364, *Natural stone test methods – Determination of the breaking load at dowel hole*

BS EN ISO 3506-1, *Mechanical properties of corrosion-resistant stainless steel fasteners – Part 1: Bolts, screws and studs*

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

3 Terms and definitions

For the purposes of this part of BS 8298, the terms and definitions given in BS 8298-1 apply.

4 Thickness of stone

4.1 General

The thickness of stone (other than soffit stones) selected for use should be:

- a) determined by structural calculation or performance testing to establish the properties of the stone (particularly the flexural strength and the breaking load at dowel); or
- b) in accordance with Annex A, if it is agreed that a) is not appropriate.

NOTE 1 The required thickness depends on the properties of the stone (particularly flexural strength), the panel size, the imposed loads and the fixing system. It is also necessary to consider both the flexural strength of the panel between fixing points and the failure load at the fixing point. These are then compared to the expected lateral wind loads and vertical dead loads.

NOTE 2 Given that there are a number of variables and that the designer can start with any of these, the process by which all of the parameters are determined is potentially very complex. In order to produce a simplified scheme, it is assumed that under normal circumstances two variables are likely to be known: the stone type (4.2) and the panel dimensions and thickness (4.3).

4.2 Known stone type

It is essential that the recent technical data are obtained for the stone (results from samples collected from the same bed/quarry within the last two years are considered to be recent). In particular, the flexural strength and the resistance of the fixings to lateral loads should be documented. Additionally, information on the likely lateral loads should be either calculated using the methods and factors given in BS EN 1991-1-4 or defined using the classification in Table 1.

NOTE It can be beneficial to view past records to build up a picture of the stone's performance and to compare its potential performance on site with the test data provided by the product supplier.

Table 1 Classification of wind load environments in the UK

Class	Load N·m ⁻²	Brief description
Low	1 500	A sheltered environment such as the lower floors of a building in a central urban area, e.g. Central Manchester
Medium	2 250	An exposed environment such as the higher floors of a tall building or a more exposed location, e.g. Canary Wharf, London
High	3 000	An exposed environment such as a coastal location

4.3 Known panel dimensions and thickness

4.3.1 General

Where the panel dimensions and thickness are known, Table 2, Table 3, Table 4 and Table 5 should be used to determine the minimum values for the flexural strength (see 4.3.2) and the strength around the fixing (see 4.3.3). These values can then be used in the specification for the stonework.

EXAMPLE

- Panel dimensions: 900 mm × 600 mm
- Panel thickness: 50 mm
- Fixing system: dowels in the short sides
- Location: high wind load environment
- Minimum flexural strength: 4.37 MPa
- Minimum strength around the fixings: 3 600 N

4.3.2 Flexural strength

The flexural strength (in MPa) should be determined in accordance with BS EN 12372 or BS EN 13161 and should be not less than that shown in Table 2, Table 3 or Table 4, as relevant to the greatest panel span and thickness. Wet testing should also be requested in accordance with BS EN 12372, BS EN 13161 or BS EN 13364, as appropriate with the samples soaked in potable water at 22° C ± 2° C for 48 hours prior to strength testing.

NOTE 1 Flexural strength is the mean value for 10 or more specimens.

NOTE 2 The greatest panel span is the maximum distance between fixings measured parallel to the sides of the panel.

NOTE 3 A factor of safety of 6 has been included in the calculations. Where flexural strength testing is carried out dry, a higher factor of safety might be needed as the exact increase depends on whether the actual flexural strength is determined wet and dry.

Deviations in the nominal thickness of the stone should be in accordance with Clause 8.

Table 2 Low wind load environment: minimum flexural strength

Panel span between fixings mm	Minimum flexural strength based on panel thickness (t)					
	MPa					
	t = 20 mm	t = 30 mm	t = 40 mm	t = 50 mm	t = 60 mm	t = 70 mm
300	1.52	0.68	0.38	0.24	0.17	0.12
450	3.42	1.52	0.85	0.55	0.38	0.28
600	6.08	2.70	1.52	0.97	0.68	0.50
750	9.49	4.22	2.37	1.52	1.05	0.77
900	13.67	6.08	3.42	2.19	1.52	1.12

Table 3 Medium wind load environment: minimum flexural strength

Panel span between fixings mm	Minimum flexural strength based on panel thickness (t)					
	MPa					
	t = 20 mm	t = 30 mm	t = 40 mm	t = 50 mm	t = 60 mm	t = 70 mm
300	2.28	1.01	0.57	0.36	0.25	0.19
450	5.13	2.28	1.28	0.82	0.57	0.42
600	9.11	4.05	2.28	1.46	1.01	0.74
750	14.24	6.33	3.56	2.28	1.58	1.16
900	20.20	9.11	5.13	3.28	2.28	1.67

Table 4 High wind load environment: minimum flexural strength

Panel span between fixings mm	Minimum flexural strength based on panel thickness (t)					
	MPa					
	t = 20 mm	t = 30 mm	t = 40 mm	t = 50 mm	t = 60 mm	t = 70 mm
300	3.04	1.35	0.76	0.49	0.34	0.25
450	6.83	3.04	1.71	1.09	0.76	0.56
600	12.15	5.40	3.04	1.94	1.35	0.99
750	18.98	8.44	4.75	3.04	2.11	1.55
900	27.34	12.15	6.83	4.37	3.04	2.23

4.3.3 Breaking load at the fixings

The breaking load at the fixings and the resistance to lateral loads should be determined in accordance with BS EN 13364 and should be not less than that shown in Table 5.

NOTE 1 The load varies with the panel area and the lateral loading.

The breaking load at the fixings should be taken as the mean value for 10 or more specimens when tested wet (see 4.3.2).

As the result is based on the thickness of the test specimens, this should be based on the thickness indicated by Table 2, Table 3 and Table 4.

NOTE 2 Available data indicate that the strength around the fixing might be the more critical value and might affect the thickness.

NOTE 3 The panel area is taken as the maximum height in metres multiplied by the maximum width in metres.

NOTE 4 A factor of safety of eight has been included in the breaking load calculations in Table 5. Where flexural strength testing was carried out in dry conditions, a higher factor of safety might be needed, e.g. 9 rather than 8.

Deviations in the nominal thickness of the stone should be in accordance with Clause 8 and BS 8298-1:2010, 7.2.2.

Table 5 Minimum breaking load at the fixing

Panel area m ²	Minimum breaking load based on location		
	N		
	Low wind load environment	Medium wind load environment	High wind load environment
0.4	1 200	1 800	2 400
0.5	1 500	2 250	3 000
0.6	1 800	2 700	3 600
0.7	2 100	3 150	4 200
0.8	2 400	3 600	4 800
0.9	2 700	4 050	5 400

4.4 Impact resistance

The risk of impact on the surface of the cladding system should be considered at the design stage and the recommendations of BS 8298-1:2010, 6.14 should be followed.

4.5 Cramp mortices and sunken dressed margins

The minimum thickness of stone in front or behind a slot or mortice should be suitable for its intended application. In the absence of any specific testing or calculation, the minimum thickness should be 12 mm for stones of 15 MPa mean flexural strength or greater, and 25 mm for all stones below 15 MPa. The location and type of different fixings should also be assessed using performance testing and/or calculation. Where stone might be vulnerable to impact damage, such as at plinth (ground) level, additional measures, e.g. using thicker stones in the affected area, or sealing the backs of the stones before fixing and then filling the cavity with a lightweight fine concrete mix after fixing, should be used.

Rebates can extend the full length of the stone (particularly where the stone is seated on a continuous angle). The quantity of stone left in front of the rebate is dictated by the type of stone: the performance under lateral load should then be determined by testing. In the absence of any specific testing or calculation, the minimum thickness should be 12 mm for stones of 15 MPa mean flexural strength or greater, and 25 mm for all stones below 15 MPa.

Where the design of the cladding incorporates a sunken dressed margin to provide a recessed joint (rustications) where it coincides with any fixings, its size should not compromise the performance of the stone.

Where fixings are located in the same joint as the rustication, the overall thickness of the stone should be increased or specifically tested in accordance with BS EN 13364.

4.6 Soffit stones

Soffit stones should not exceed 900 mm × 600 mm. If stones of a greater size are required, they should be justified by calculation.

In the absence of any specific calculation, the minimum thickness should be 40 mm for stones of 15 MPa mean flexural strength or greater, and