

BS 5534:2014



BSI Standards Publication

# Slating and tiling for pitched roofs and vertical cladding – Code of practice

**bsi.**

...making excellence a habit.™

**Publishing and copyright information**

The BSI copyright notice displayed in this document indicates when the document was last issued.

© The British Standards Institution 2014

Published by BSI Standards Limited 2014

ISBN 978 0 580 80704 6

ICS 91.060.20

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

Committee reference B/542/1

Draft for comment 13/30271503 DC

**Publication history**

First published as CP 142, September 1942

Second edition, January 1958

Third edition, April 1968

Fourth edition, October 1971

Fifth edition as BS 5534-1, April 1978

Sixth edition as BS 5534-1, September 1997

Seventh edition as BS 5534, June 2003

Eighth (present) edition, August 2014

**Amendments issued since publication**

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

---

## Contents

Foreword v

<b>1</b>	<b>Scope</b>	<b>1</b>
<b>2</b>	<b>Normative references</b>	<b>1</b>
<b>3</b>	<b>Terms, definitions and symbols</b>	<b>4</b>
<b>4</b>	<b>Materials, fittings and accessories</b>	<b>11</b>
4.1	Clay tiles and fittings (single-lap and double-lap)	11
4.2	Concrete tiles and fittings (single-lap and double-lap)	11
4.3	Fibre-cement slates and fittings	11
4.4	Natural slates and fittings	11
4.5	Bitumen shingles	12
4.6	Proprietary products	12
4.7	Wooden shingles and shakes	12
4.8	Metal tiles	12
4.9	Roofing underlay	12
4.10	Board and sheet sarking	14
4.11	Timber battens and counterbattens	16
4.12	Mechanical fixings	18
4.13	Flashings and junctions	21
4.14	Mortar	21
4.15	Other fittings and accessories	23
<b>5</b>	<b>Design criteria</b>	<b>26</b>
5.1	General	26
5.2	Structural stability	27
5.3	Resistance to wind uplift	28
5.4	Rain and snow resistance	33
5.5	Minimum pitch, head-laps and side-laps for roofs	42
5.6	Minimum head-laps, side-laps and overlaps for walls (75° pitch and above)	48
5.7	Aesthetics	48
5.8	Durability	49
5.9	Hygrothermal factors	52
5.10	Fire	54
5.11	Sound	55
5.12	Sustainability	55
<b>6</b>	<b>Application and installation details</b>	<b>55</b>
6.1	General	55
6.2	Underlays	56
6.3	Battens, counterbattens and sarking boards	58
6.4	Double-lap clay and concrete plain tiles	60
6.5	Single-lap clay and concrete interlocking tiles	64
6.6	Fibre-cement slates	68
6.7	Natural slates	72
6.8	Bitumen shingles	77
6.9	Metal tiles	78
6.10	Wooden shingles and shakes	79
6.11	Other tiles and artificial slates (non-traditional)	79
6.12	Vertical (75° or steeper) slating, tiling and shingling	80
6.13	Roof drainage, flashings and weatherings	81
6.14	Workmanship, repairs and maintenance	84

**Annexes**

- Annex A (normative) Method of test and classification of roof underlays for wind uplift resistance 85
- Annex B (normative) Design and installation of pitched roof systems where insulation is placed at rafter level 92
- Annex C (normative) Reinforced bitumen underlays 98
- Annex D (normative) Permissible characteristics and defects for grading timber battens and counterbattens 100
- Annex E (normative) Preservative treatment for timber battens 103
- Annex F (normative) Determination of batten sizes by calculation 104
- Annex G (informative) Examples of structural design calculations for tiling battens 105
- Annex H (normative) Formulae and the calculation of wind loads on the underlay, sarking boards, slates, tiles, ridges, hips and valleys 110
- Annex I (normative) Method of test and calculation for wind uplift resistance of mechanical fasteners for single-lap tiles 125
- Annex J (normative) Method of test and calculation for wind uplift resistance of nail hook fixings for double-lap slates 134
- Annex K (informative) Worked examples of wind uplift and fixing calculations 139
- Annex L (normative) Method of test for air permeability of unsaled small element roofing assemblies 152
- Bibliography 157

**List of figures**

- Figure 1 – Drive slate hook dimensions 20
- Figure 2 – UK map of categories of exposure to driving rain 35
- Figure 3 – Laps for centre-nailed, head-fixed and shoulder-fixed double-lap slates 36
- Figure 4 – Lap and pitch of slates in double-lap slating 37
- Figure 5 – Lap and pitch of tiles in double-lap plain tiles 38
- Figure 6 – Lap and pitch of tiles in single-lap tiles 39
- Figure 7 – Valley gutter with unbedded and bedded tiles or slates 82
- Figure A.1 – Layout of test assembly 86
- Figure A.2 – Cross-section of test assembly (shown with uplift pressure applied) 87
- Figure A.3 – Locations of nails for nailing overlap to rafter 88
- Figure A.4 – Design wind pressures for geographical wind zones in the UK for underlays used for specific applications conforming to conditions in A.7 90
- Figure A.5 – Illustration of a zonal-classification label for an underlay 91
- Figure B.1 – Force diagram of vectored load down a roof slope 94
- Figure B.2 – Bending stress in a fixing through rigid insulation 95
- Figure B.3 – Bending moment diagram of a fixing through rigid insulation 96
- Figure B.4 – Deflection diagram of a fixing through rigid insulation 96
- Figure D.1 – Examples of knot configurations 100
- Figure D.2 – Permissible wane 101
- Figure D.3 – Permissible depth of fissures 101
- Figure D.4 – Permissible slope of grain 101
- Figure D.5 – Permissible rate of growth 102
- Figure D.6 – Measurement of distortion 103
- Figure G.1 – Loads and bending moments on roof battens 106
- Figure H.1 – Key for  $c_{p,net}$  data for duopitch and hipped roofs 112
- Figure H.2 – Key for  $c_{p,net}$  data for monopitch roofs 113
- Figure H.3 – Wind uplift loading on single-lap tiles, including where the eaves overhang exceeds 60 mm 115
- Figure H.4 – Wind uplift loading on double-lap slates or tiles, including where the eaves overhang exceeds 60 mm 116
- Figure H.5 – Wind uplift loading on single-lap tiles where the verge overhang exceeds 60 mm 117

- Figure H.6 – Distances around obstructions 118  
 Figure H.7 – Wind uplift loading on ridges and hips 120  
 Figure I.1 – Example of an arrangement of the test apparatus for determination of clip strength for single-lap tiles 126  
 Figure I.2 – Example of a hinged batten for supporting a clipped test tile 127  
 Figure I.3 – Tiles laid in straight bond 128  
 Figure I.4 – Tiles laid in broken (half) bond 129  
 Figure I.5 – System of forces in an array of clipped tiles under uplift load 133  
 Figure J.1 – Example of an arrangement of the test apparatus for determination of nail hook fixing strength for double-lap slates 135  
 Figure K.1 – Dimensions and forces acting on a single-lap tile 140  
 Figure K.2 – Dimensions and forces acting on a plain tile 143  
 Figure K.3 – Dimensions and forces on centre-nailed double-lap slating with an example of slate hook arrangement 149  
 Figure L.1 – Arrangement of apparatus 153  
 Figure L.2 – Plenum chamber arrangement for air permeability test 154

#### List of tables

- Table 1 – Material specifications for board and sheet sarking 15  
 Table 2 – Material specifications for insulated board sarking 15  
 Table 3 – Minimum timber batten sizes (roofing and vertical work) 17  
 Table 4 – Dimensions of drive slate hooks 20  
 Table 5 – Materials for flashings and junctions 22  
 Table 6 – Recommended standard mortar mixes for slating and tiling (all proportions by volume) 22  
 Table 7 – Minimum spacing of nails and screws 33  
 Table 8 – Values of  $c$  for head-lap calculations for double-lap fibre-cement and natural slates, nail-fixed or hook-fixed 44  
 Table 9 – Minimum head-laps and  $E_1$  factors for double-lap fibre-cement and natural slates, pegged, nailed or hook-fixed 45  
 Table 10 – Head-laps for underlay 56  
 Table 11 – Minimum widths of valley gutter for different roof pitches and plan areas 82  
 Table 12 – Minimum width of lead to line valley gutters for different roof pitches and plan areas 83  
 Table C.1 – Recommendations for mass per unit area of constituent materials 99  
 Table F.1 – Gauge grade bending stresses and moduli for batten timber species 105  
 Table H.1 – Net uplift coefficient,  $c_{p,net}$  for single-lap tiles and double-lap slates 111  
 Table H.2 – Net uplift coefficient,  $c_{p,net}$  for plain tiles 111  
 Table H.3 – Summarized values of external pressure coefficient,  $c_{pe}$  112  
 Table H.4 – Values of roof substrate shielding factor,  $S$  114  
 Table H.5 – Design ultimate withdrawal resistance against wind loading for nails 123  
 Table H.6 – Design ultimate withdrawal resistance against wind loading for screws 123  
 Table H.7 – Values of  $K_n$  for tiles 124  
 Table H.8 – Wind uplift resistance of twice nailed plain tiles 125  
 Table I.1 – Values of  $k_n$  for single-lap tile fasteners 131  
 Table J.1 – Values of  $k_n$  for slate hooks 137  
 Table K.1 – Wind uplift resistance of twice nailed plain tiles fixed in various patterns assuming aluminium nails meeting the recommendations of Table H.8 144

Table K.2 – Wind uplift resistance of twice nailed plain tiles fixed in various patterns assuming stainless steel nails meeting the recommendations of Table H.8 146

Table L.1 – Arrangement of unsealed elements 153

Currently in preview, click buy full version

**Summary of pages**

This document comprises a front cover, an inside front cover, pages i to vi, pages 1 to 162, an inside back cover and a back cover.

## Foreword

### Publishing information

This British Standard is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 31 August 2014. It was prepared by Subcommittee B/542/1, *Slating and tiling*, under the authority of Technical Committee B/542, *Roofing and cladding products for discontinuous laying*. A list of organizations represented on this committee can be obtained on request to its secretary.

### Supersession

This British Standard supersedes BS 5534:2003+A1:2010, which will be withdrawn on 28 February 2015.

### Relationship with other publications

This British Standard is intended to be read in conjunction with BS 5250, BS 9250 and BS 8000-6.

### Information about this document

This British Standard was first published as BS 5534-1 in April 1978 and was updated in 1990, 1997 and 2003. BS 5534-2 was first published in November 1986 and was withdrawn on publication of BS 5534-1:1997, by which it was superseded.

This is a full revision of the standard, and includes a complete re-structuring intended to make the standard more usable in addition to introducing the following principal changes.

- a) Subclause 5.2 and Annex H, which deal with structural stability, have been revised to reflect new knowledge and experience on wind loads and uplift resistances of the roof covering and underlay, expressed in terms of the relevant Eurocode, for basis of structural design, enhanced safety factors, loads and resistances.
- b) The worked examples of wind uplift and fixing calculations given in Annex K have been updated.
- c) Wind uplift resistance of self-supporting underlays has been included. A pressure test (Annex A) has been introduced to determine the wind uplift resistance of underlays in order to determine their scope of application and classification.
- d) Clause 6, which deals with application and design details has been revised, including references to workmanship, which are now covered in the 2013 revision of BS 8000-6.
- e) Reliance on the tensile strength of mortar bedding to resist wind uplift has been withdrawn.

Updated information relating to the preservative treatment of timber battens has been contributed by the Wood Protection Association ([www.wood-protection.org](http://www.wood-protection.org))<sup>1)</sup>.

**Product certification.** Designers and specifiers are advised to consider the desirability of using roofing products, fittings and accessories that are supported by recognized UKAS-accredited third-party assessment.

<sup>1)</sup> Last accessed 26 August 2014.

### Use of this document

As a code of practice, this British Standard 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 British Standard is expected to be able to justify any course of action that deviates from its recommendations.

### Presentational conventions

The provisions of 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.*

Where words have alternative spellings, the preferred spelling of the Shorter Oxford English Dictionary is used (e.g. "organization" rather than "organisation").

In the case of "sulfur" (and its derivatives), the International Union of Pure and Applied Chemistry (IUPAC) spelling is used.

### 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.**

Particular attention is drawn to the Control of Substances Hazardous to Health Regulations 2002 [1].

## 1 Scope

This British Standard gives recommendations for the design, performance and installation of pitched roofs and vertical cladding using slates, tiles, shingles and shakes and their associated components. It does not cover the structural design of the roof.

*NOTE* Recommendations for workmanship, repair and maintenance are given in BS 8000-6.

This British Standard does not give detailed recommendations for special roof types such as curved or random slating, but it does give recommendations for determining minimum roof pitches and calculating the minimum head-laps and side-laps that can be used for such types of slating.

This British Standard is intended for use by designers, manufacturers and installers of roofing products.

## 2 Normative references

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

### Standards publications

BS 416-1, *Discharge and ventilating pipes and fittings, sand-cast or spun in cast iron – Part 1: Specification for spigot and socket systems*

BS 1202-2, *Specification for nails – Part 2: Copper nails*

BS 1202-3, *Specification for nails – Part 3: Aluminium nails*

BS 2000-49 (BS EN 1426), *Bitumen and bituminous binders – Part 49: Determination of needle penetration*

BS 2000-58 (BS EN 1427), *Bitumen and bituminous binders – Part 58: Determination of the softening point – Ring and ball method*

BS 4841-5, *Rigid polyisocyanurate (PIR) and polyurethane (PUR) products for building end-use applications – Part 5: Specification for laminated boards (roofboards) with auto-adhesively or separately bonded facings for use as thermal insulation boards for pitched roofs*

BS 5250, *Code of practice for control of condensation in buildings*<sup>2)</sup>

BS 6000-6, *Building and civil engineering – Vocabulary – Part 6: Construction parts*

BS 8000-6, *Workmanship on building sites – Code of practice for slating and tiling of roofs and claddings*<sup>3)</sup>

BS 8417, *Preservation of wood – Code of practice*

BS 9250, *Code of practice for design of the airtightness of ceilings in pitched roofs*

BS EN 197-1:2011, *Cement – Part 1: Composition, specifications and conformity criteria for common cements*

BS EN 300:2006, *Oriented strand boards (OSB) – Definitions, classification and specifications*

<sup>2)</sup> This standard also gives informative references to BS 5250:2011.

<sup>3)</sup> This standard also gives an informative reference to BS 8000-6:2013.