
British Standard

Wall and floor tiling

Part 1. Code of practice for the design and installation of
internal ceramic wall tiling and mosaics in normal conditions

Foreword

This Part of BS 5385 has been prepared under the direction of the Elements and Components (of Diverse Materials) for Buildings Standards Policy Committee. It is a revision of the 1976 edition which has been revised to take cognizance of the latest techniques and materials now used in wall tiling, and a section on protection and cleaning, as well as illustrations of typical wall tile fittings, has been added.

For the purposes of this code 'normal conditions' imply normal environmental temperature and humidity. However, it is not to be inferred from this that all recommendations made in this code are unsuitable for more extreme conditions.

Throughout this code, references to tiles and tiling are intended to apply equally to mosaics and mosaic work except where the recommendations for mosaics are different, as in section five.

This Part of BS 5385 is now one of a series dealing with the installation of floor, as well as wall tiling, the other Parts of BS 5385 are as follows.

- Part 2 Code of practice for external ceramic wall tiling and mosaics
- Part 3 Code of practice for the design and installation of ceramic floor tiles and mosaics
- Part 4 Code of practice for ceramic tiling and mosaics in specific conditions
- Part 5 Code of practice for the design and installation of terrazzo tile and slab, natural stone and composition block floorings

Assessed capability. Users of this British Standard are advised to consider the desirability of assessment and registration of a supplier's quality systems against the appropriate Part of BS 5750 by a third party certification body.

Enquiries as to availability of third party certification schemes will be forwarded by BSI to the Association of Certification Bodies. If a third party certification scheme does not already exist, users should consider approaching an appropriate body from the list of Association members.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

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installation of internal ceramic wall tiling and
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Correction

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Clause 17.2.1 General

In paragraph 2 delete '4 weeks' and substitute '6 weeks'.

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Section one. General

1 Scope

This Part of BS 5385 gives recommendations for the design and installation of internal ceramic wall tiling and mosaics in normal conditions. It deals with classes and types of background and their suitability to receive tiling using the following fixing methods, which are described in the relevant sections:

- (a) bedding in cement-based adhesives on an intermediate substrate or as a direct bedding method;
- (b) bedding in organic-based adhesives on an intermediate substrate or as a direct bedding method;
- (c) bedding in cement:sand mortar on rendering or as a direct bedding method.

Tile fittings for use at corners and edges are given in appendix A.

Where the tiling installation needs to meet specific functional or environmental requirements, or to assist in counteracting potentially detrimental effects on the installation and/or the structure, reference should be made to BS 5385 : Part 4. The specific conditions dealt with in BS 5385 : Part 4, for example, swimming pools, shower areas, etc. are listed in appendix B.

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

2 Definitions

For the purposes of this Part of BS 5385 the definitions given in BS 6100 and BS 6431 : Part 1 apply.

3 Exchange of information and time schedules

NOTE. This clause deals with the exchange of information for the whole wall, including tiles, tile bed, background and intermediate substrate (if any).

3.1 Exchange of information

Working drawings and specifications should be prepared in sufficient detail to afford proper guidance in the design and execution of the work. At the tendering stage the following information should be provided.

- (a) *Site*. Location and means of access.
- (b) *Building*. Nature of building and particulars of corrosive or other potentially damaging conditions to which the installation may be subjected in service (e.g. mechanical cleaning).

- (c) *Wall(s)*. Type and age of construction, location within the building, type and accuracy of background and need for intermediate substrate.
- (d) *Associated work*. Services embedded in or passing through the wall, skirtings and abutments, junctions with other adjacent finishes.
- (e) *Finishes*. Type(s) of tiles and/or mosaics, bedding and jointing requirements and required surface plane.
- (f) *Contract*. Particulars if the work is to be completed in any specific order or in sections.
- (g) *Health and safety*. Information on articles and substances for use during the work that are liable to be a health risk.
- (h) *Time schedule*. A time schedule for the progress of the work. (See 3.3.)
- (i) *Testing*. Details of any compliance testing required.

3.2 Provision of utilities, facilities and materials

3.2.1 General. To prevent misunderstanding, particularly at the tendering stage, and to avoid possible situations detrimental to installation, it should be made clear whether or not the following will be provided and by whom:

- (a) adequate, clean, dry, lockable storage space protected from frost if necessary;
- (b) clean water supply adjacent to working areas;
- (c) adequate artificial lighting, if required (see 3.2.2);
- (d) safe means of access and places of work, to include where required, suitable scaffolding and staging, which should be in accordance with the requirements of the Building and Construction Regulations made under the Factories Act and comply with BS 5973;
- (e) unloading and hoisting facilities;
- (f) electric power supply adjacent to working areas;
- (g) protection of work during and after fixing;
- (h) supplies of cement and sand in accordance with clauses 7 and 8.

3.2.2 Lighting on site. Lighting on site should be of the same type, direction and intensity as envisaged for the completed installation. If this condition is not met then the appearance of the finished wall may be significantly different from that originally intended. This is a matter which should be appreciated by the specifier at the design stage.

3.3 Time schedules

The time schedule for the whole building work should be planned in the initial stages before operations are begun and, where possible, in consultation with those who will become responsible for carrying out the work of each of the trades concerned.

Before tiling commences at least 6 weeks should be allowed for a new concrete or masonry wall to dry out. If rendering is subsequently to be applied, it should be left for at least a further 2 weeks. New gypsum plasterwork should be left for at least 4 weeks. These times may require extension depending on the conditions on site and the mass of the structure.

The schedule should allow time for all cutting of holes and chases in the walls to be tiled and in adjacent walls before any intermediate substrate is applied.

Provision should also be made for the completion of all subsidiary work necessary before the application of tiles or mosaic systems begins. The schedule should include times for commencement and completion of tiling or mosaic work in the different parts of the building, allowing sufficient time intervals between the bedding, grouting and final cleaning down.

Tiling can be adversely affected by frost during installation and provision should be made in the time schedule to allow for suspension of operations during freezing conditions.

Section two. Materials

4 Transport and storage

The delivery of materials should be so arranged as to minimize handling. Adequate precautions should be taken to guard against the possibility of damage.

Products should be stored in a clean, dry, frost free (if necessary) lockable storage to avoid excessive handling, theft and damage.

5 Ceramic tiles

These are classified in BS 6431 : Part 1 and fall into two main classes according to their method of manufacture.

(a) *Extruded tiles (shaping A)*, whose body is shaped in the plastic state in an extruder and the resulting column cut into tiles of predetermined lengths.

(b) *Dust-pressed tiles (shaping B)*, which are formed of powder or small grains, shaped in moulds under high pressure before firing. These tiles generally are made to finer dimensional tolerances than extruded tiles.

Tiles are further sub-divided according to their water absorption: low (group I), medium (groups IIa and IIb) and high (group III); see table 1.

Tiles may be unglazed, engobed, partly glazed or glazed. The range of sizes, thicknesses and accessories varies with individual manufacturers. The range is predominantly of square or oblong shapes but other geometrical and decorative shapes are also made. Tile fittings for use at corners and edges are given in appendix A.

Properties and characteristics to which products should conform are laid down in the standards of individual products, BS 6431 : Parts 2 to 9, and the relevant standard(s) should be quoted in the specification.

6 Mosaics

Mosaics are available in a variety of shapes and sizes, in glazed and unglazed ceramic, glass and marble. To facilitate ease of handling, mosaics are assembled as sheets, the individual tessera being glued either face side down to paper (paper-faced mosaics), or bed side down to synthetic mesh, or to small tabs.

Paper-faced mosaics allow full contact to be achieved with the bed, i.e. mortar or adhesive. When sheets are assembled by means of a backing material it should be made of synthetic fabric, not of cotton or paper.

For a mosaic which has been assembled with backing fabric or tabs it is essential that:

- (a) the fabric or tabs and their adhesive should not occupy more than 25 % of the area of each tessera. The critical factor is the contact of the adhesive over the backs of the tesserae;
- (b) the fabric or tabs and their adhesive should not deteriorate in service and that they should be compatible with the mortar or adhesive bed.

The physical and chemical properties of ceramic tesserae should be in accordance with the requirements given in the relevant Part of BS 6431.

Before selecting a particular system the advice of the mosaics suppliers or mosaics fixing specialists should be obtained as to the suitability of a particular type of mosaic for a particular environment. Mosaics should not be used in corrosive situations.

7 Cement

Cement should comply with the requirements of BS 12, BS 4027 or BS 5224.

Cement should be stored under dry conditions and used in order of delivery. Cement which contains air set lumps should not be used.

8 Sand

8.1 General

All stocks of sand should be protected from rain, frost and any form of contamination.

8.2 Sand for cement:sand rendering and mortar beds

Sand should comply with type A of table 1 of BS 1199 : 1976.

Table 1. Classification of ceramic tiles

	Group I	Group IIa	Group IIb	Group III
Water absorption (E)	$E \leq 3 \%$	$3 \% < E \leq 6 \%$	$6 \% < E \leq 10 \%$	$E > 10 \%$
<i>Tile shaping</i>				
A Extruded	AI	AIla	AIlb	AIII
B Dust-pressed	BI	BIla	BIlb	BIII

8.3 Sand for grouting

For joints of normal widths 6 mm and above, sand for grouting should comply with the grading limits of type B of table 1 of BS 1199 : 1976.

For joints less than 6 mm wide, sands for grouts should comply with the grading limits given in table 2. Sands complying with type G of table 1 of BS 1200 : 1976 may be suitable, provided the fraction greater than 2.36 mm is screened off.

Table 2. Sand for grouts for joints less than 6 mm wide	
BS 410 sieve	Percentage by mass passing BS sieves
mm	% (m/m)
2.36	100
1.18	95 to 100
µm	
600	80 to 100
300	30 to 100
150	0 to 60
75	not greater than 7

9 Plaster

Plaster backgrounds to receive ceramic tiles are usually based on gypsum building plasters and should be provided in accordance with the recommendations of BS 5492.

Gypsum plasters should comply with the requirements of BS 1191 : Part 1 or Part 2.

Proprietary materials should be used strictly in accordance with the manufacturer's instructions.

10 Water

Water should be fresh and clean. Sea water is not suitable. All containers used for storing or carrying water or for soaking tiles should be clean.

11 Adhesives

11.1 Cement-based adhesives (hydraulically-hardening mortars)

These should conform to the requirements of type 1 in BS 5980 : 1980.

11.2 Organic-based adhesives

These should conform to the requirements for the following types given in BS 5980 : 1980.

- Type 2. Dispersion adhesive.
- Type 3. Dispersion/cement adhesive.
- Type 4. Dissolved resin adhesive.
- Type 5. Reaction resin adhesive.

11.3 Admixtures to adhesives

A polymer additive or some other liquid or powdered product may be incorporated in adhesives to obtain greater adhesion, improved resilience or some degree of water repellence.

Admixtures should be used strictly in accordance with the manufacturer's instructions, and they should not be added to an adhesive unless approved by the manufacturer of the adhesive.

12 Bonding agents

Bonding agents may be used to improve the adhesion of rendering and/or tile beds to backgrounds. Manufacturers recommend particular grades and methods of application depending on the materials involved and service conditions, and their instructions should be followed.

13 Sealants and back-up materials for movement joints

13.1 Sealants

Guidance on the selection and application of joint sealants is given in BS 6213.

Materials for movement joints should be composed of non-rigid materials applied either in the form of a compound or a pre-formed strip; they should combine the properties of resilience and/or plasticity within the maximum temperature ranges likely to be encountered. Table 3 provides a guide to most of the sealants in general use and a summary of their properties.

There should be no evidence of mould growth when sealants are tested by the method described in appendix B of BS 5980 : 1980.

13.2 Back-up materials

These should be compressible materials that will not force out the sealant when the joint closes. Suitable materials include cellular rubber and plastics such as cellular polyethylene, some fibre building boards, cork boards and caulking cotton. These materials are available in strip form.

14 Grouts

14.1 General

Grouts should have good working characteristics, low shrinkage and good adhesion to the sides of the joints. When selecting a grout the specifier should establish that it is suitable for the conditions it has to meet, for example, impermeability; resistance to water, heat, cleaning agents and chemical attack; resistance to mould growth and bacteria; resilience and compressibility.

Table 3. Flexible sealants: summary of properties

Type	Movement accommodation factor (see note 2)	Service temperature limits	Hardness (see note 3)	Cure time before serviceable e.g. washing down (see note 4)
Epoxide polysulphide and flexibilized epoxide (two part)	% 5 to 10	°C -20 to +80	IRHD 70 to 95	Days 1 to 7. Chemically cure. Rate of cure depends on temperature
Acrylic (emulsion type)	15	-20 to +70	10 to 50	1 to 14. Should not be exposed to water until an adequate skin has formed
Acrylic (solution type)	20	-35 to +90	25 to 30	3 to 14. Sets by solvent loss
Polysulphide (one part)	25	-20 to +80	15 to 40	7 to 21. Moisture cure. Rate of cure depends on temperature and relative humidity
Polysulphide (two part) High modulus Low modulus	20 35	-20 to +80 -20 to +80	40 to 60 15 to 20	1 to 7. Chemically cure. Rate of cure depends mainly on temperature
Polyurethane (one part)	25 to 35	-40 to +70	15 to 40	3 to 14. Moisture cure. Rate of cure depends mainly on temperature
Silicone High modulus Low modulus	25 50 to 100	-60 to +180 -50 to +120	20 to 30 10 to 20	1 to 14. Moisture cure. Rate of cure depends on temperature and relative humidity

NOTE 1. Under favourable conditions the expected service life of the sealants listed is approximately 15 years for the acrylic types and not less than 20 years for the others.

NOTE 2. The values quoted are average values varying within wider or narrower limits according to manufacture. Where the movement accommodation factor is below 15 % the sealant should not be used over structural movement joints.

NOTE 3. The figures quoted are as measured on an IRHD meter (see BS 903 : Part A26). Low figures indicate that the sealant is soft, high figures that the sealant is hard, e.g. tyre tread would have a hardness of 60° to 70° on this scale. Ranges are shown for each sealant in the table, reflecting variations encountered in practice according to the manufacturer of the product. Hardness measured in Shore A units is similar in value to that measured in IRHD units.

NOTE 4. Cure times vary according to environmental conditions, but the ranges shown in the tables also reflect variations between different manufacturers' products.

14.2 Types of grout

14.2.1 Proprietary grouts. These are generally one of the following types:

- (a) mixes based on cement but modified by the inclusion of various additives, that require only the addition of clean water to obtain the desired consistency;
- (b) ready-mixed, organic polymer-based compositions;
- (c) mixes based on epoxide resin; these are supplied as two or three separate components, in pre-gauged pro-

portions, which have to be mixed together immediately before use.

Materials of type (a) are used in most normal tiling situations. Those of types (b) and (c) find application where special service requirements apply, e.g. hardness, imperviousness, resistance to cleaning agents etc.

NOTE. Epoxide resin mixes are more expensive than those based on cement and the treatment of joints using these compositions is slower.

Proprietary grouts should be stored and used in accordance with the particular manufacturer's instructions but, in general, they do not require prior wetting of the tile joints before use.

14.2.2 Cement:sand mortar grouts. These are sometimes used for grouting joints over 3 mm wide (see **24.3**). Mixes of this kind need dampness in the joint cavities to promote good adhesion and are best suited for use with cement:sand mortar bedding systems where, if necessary, the joints can be re-wetted without affecting the bed.

NOTE. The physical properties of a cement:sand mortar grout are likely to be inferior to those of proprietary grouts, which offer the advantages of controlled formulations and consistency.

A grout composition consisting of ordinary cement and whitening should not be used.

Neat cement mixed with water is not a satisfactory grout except for mosaics.

14.3 Coloured grouts

Many proprietary grouts are available in various colours as well as white. Coloured joints can also be achieved by adding pigments to proprietary materials and cement:sand compositions providing they are used in accordance with the manufacturer's instructions.

Pigments should be inorganic and compatible with the grout. When used in cement:sand compositions of cement-based proprietary materials they should also be alkali-resistant. Some organic pigments may be suitable for incorporating in epoxide resin-based grouts.

14.4 Admixtures to cement:sand mortar grout materials (other than colouring pigments)

A polymer additive or some other liquid or powdered product may be incorporated in the grout mix to obtain greater adhesion, improved resilience or some degree of water repellence.

In all such cases admixtures should be used strictly in accordance with the manufacturer's instructions, and they should not be added to a proprietary grouting product unless approved by the manufacturer of that product.

14.5 Resistance to moulds and bacteria

For normal internal installations, cement-based mixtures are generally used and offer good resistance to the growth of moulds and bacteria. Where an exceptionally high standard of hygiene is essential, e.g. food preparation areas, operating theatres, pathology laboratories, etc., epoxide resin-based materials are superior to cement-based mixtures by virtue of their impermeability and ease of cleaning and decontamination.

When tested as described in appendix B of BS 5980 : 1980, grouts should not show any evidence of mould growth.

15 Mechanical support for cement : sand rendering

15.1 General

Metal used to reinforce rendering should be galvanized steel or stainless steel and metal fixings should be compatible. (See clause **16** of BS 5262 : 1976.)

15.2 Expanded metal lathing

This material should comply with the requirements of BS 1369 : Part 1.

15.3 Ribbed lathing

This material should comply with the requirements of BS 1369 : Part 1. Ribs are formed integrally with expanded metal, thus providing rigidity.

15.4 Welded wire mesh

Plain welded wire mesh should either be galvanized after manufacture in accordance with the requirements of BS 729 or, be of stainless steel. It should be of 25 mm to 50 mm mesh and have wires not less than 1.02 mm diameter. One proprietary type, which is self-firring, is manufactured from wires galvanized in accordance with the requirements of BS 443 and includes additional stainless steel wires and an interwoven layer of absorptive paper. A water-resistant breather paper is fixed to the back. It has a mesh aperture of 38 mm x 50 mm. This type is designed to be fixed principally with stainless steel fixings.

15.5 Galvanized wire netting

Netting should be of 20 mm to 38 mm mesh and comply with the requirements of BS 1485.

15.6 Corner and stop beads

These should comply with the requirements of BS 6452 : Part 1.

15.7 Plastics coated glass fibre mesh sheets and plastics netting

These are proprietary products and should be used strictly in accordance with the manufacturer's instructions.