

Wall and floor tiling —

Part 5: Code of practice for the design and installation of terrazzo tile and slab, natural stone and composition block floorings

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- British Ceramic Tile Council
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- Department of the Environment (Building Research Establishment)
- Federation of Master Builders
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- National Federation of Clay Industries
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- National Master Tile Fixers' Association
- National Tile, Faience and Mosaic Fixers' Society
- Natural Slate Quarries Association
- Royal Institute of British Architects
- Stone Federation

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Foreword

This Part of BS 5385 has been prepared under the direction of the Technical Sector Board for Building and Civil Engineering. It supersedes BS 5385-5:1990 which is withdrawn. It is the fifth in a series of Parts of BS 5385 dealing with the installation of wall and floor tiling, the others being:

- *Part 1: Code of practice for the design and installation of internal ceramic and natural stone wall tiling and mosaics in normal conditions;*
- *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.*

This edition introduces technical changes to the recommendations for bedding some natural stone tiles and the examples of movement joints have been redrawn. However, this edition does not reflect a full review or revision of the standard, which will be undertaken in due course.

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.

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 the availability of third party certification schemes are 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.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 34, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Section 1. General

1.1 Scope

This Part of BS 5385 gives recommendations for the design and installation of terrazzo tile and slab and natural stone internal and external floorings and for composition blocks as internal flooring. The recommendations for natural stone flooring are for units no greater than 0.6 m² in area.

The types of bedding methods that may be used and their suitability are given; also recommendations for the protection, cleaning and maintenance of the finished floor surface.

Reference is made to floorings bedded directly to a screed. For the design and construction of screeds reference should be made to BS 5385-3.

1.2 References

1.2.1 Normative references

This Part of BS 5385 incorporates, by dated or undated reference, provisions from other publications. These normative references are made at the appropriate places in the text and the cited publications are listed on page 36. For dated references, only the edition cited applies; any subsequent amendments to or revisions of the cited publication apply to this Part of BS 5385 only when incorporated in the reference by amendment or revision. For undated references, the latest edition of the cited publication applies, together with any amendments.

1.2.2 Informative references

This Part of BS 5385 refers to other publications that provide information or guidance. Editions of these publications current at the time of issue of this standard are listed on the inside back cover, but reference should be made to the latest editions.

1.3 Definitions

For the purposes of this Part of BS 5385 the definitions given in BS 6100-1 and BS 6100-6 apply. An illustration of some definitions is given in Figure 1.

1.4 Exchange of information and time schedules

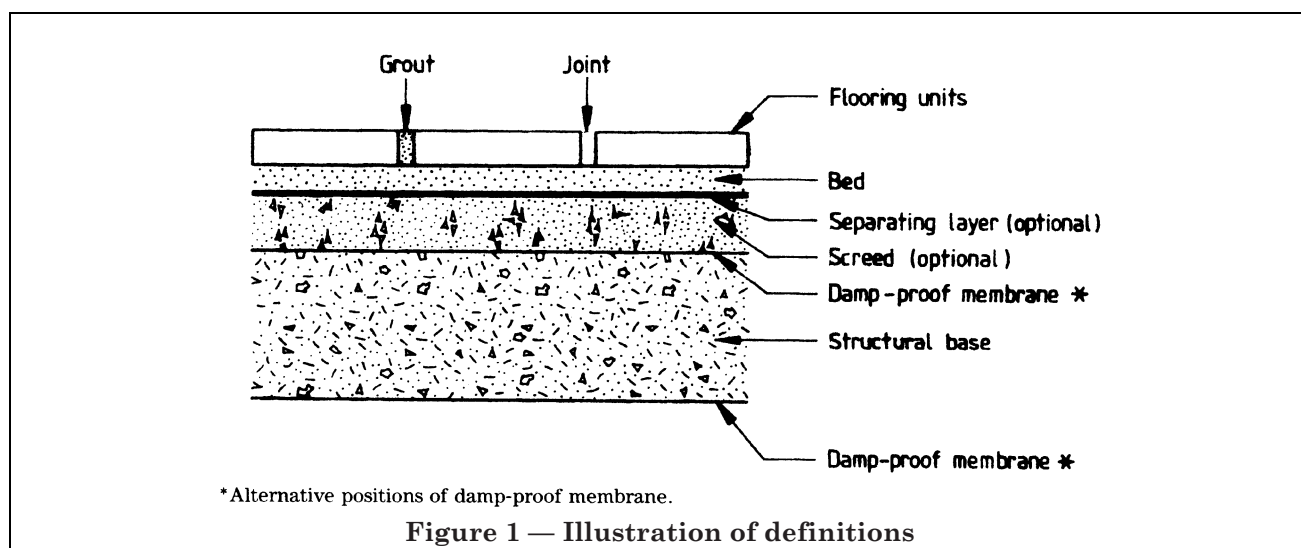
NOTE This clause deals with the exchange of information for the whole floor, including the flooring, bed, base and screed (if any).

1.4.1 Exchange of information

The working drawings and specifications should be prepared in sufficient detail to afford proper guidance in the preparation of estimates and the 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, assessment of type and density of traffic, particulars of corrosive or other potentially damaging conditions to which the installation may be subjected in service.
- c) *Floor*. Structural floor, type of damp-proof membrane and its location within the floor construction, details of screed (including its surface regularity and the category of soundness required), curing and drying times, particulars of any floor warming installation, separating layer, movement joints, finished floor levels and falls with permissible deviations.
- d) *Associated work*. Services embedded in or passing through the floor, skirtings and abutments, junctions with other adjacent flooring.



- e) *Finishes*. Type of finishing product, bedding and jointing requirements and required surface plane.
- f) *Contract*. Details, 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 hazard.
- h) *Time schedule*. A time schedule for the progress of the work.
- i) *Testing*. Details of any compliance testing required.

1.4.2 Provision of utilities, facilities and materials

1.4.2.1 General

To prevent misunderstanding, particularly at the tendering stage, it should be made clear whether or not the following will be provided and by whom:

- a) adequate clean dry storage (lock-up);
- b) clean water supply adjacent to working areas;
- c) adequate artificial lighting if required (see 1.4.2.2);
- d) suitable scaffolding and staging, attention is drawn to the requirements of the Construction (Working Places) Regulations 1966 made under the Factories Act 1961;
- e) unloading and hoisting facilities;
- f) electric power supply adjacent to working areas;
- g) protection of work during and after fixing;
- h) supplies of sand and cement in accordance with 2.5 and 2.7.

1.4.2.2 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 floor might be different from that originally intended. This is a matter which should be appreciated by the specifier at the design stage.

1.4.3 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.

At least 6 weeks should be allowed for the structural floor to undergo initial drying shrinkage. If a screed is subsequently to be applied the screed should be left for at least a further 3 weeks. The only exception is where the flooring is to be fixed by the separating layer method. If the separating layer is directly over the structural floor the period of 6 weeks may be reduced.

The schedule should allow time for all cutting of holes and chases in the floor which is to receive the bedding.

Provision should be made for adjustment to the time schedule to allow for suspension of operations due to unfavourable weather or other conditions that jeopardize the success of the installation.

Alternatively, consideration should be given to the possibility of providing a protective enclosure, e.g. cocooning, to enable work to continue during unfavourable conditions.

Section 2. Materials

2.1 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 area provided on the site and stacked in such a way that excessive handling, theft and damage are avoided.

2.2 Terrazzo tiles and slabs

Terrazzo tiles should conform to BS 4131. These have a wear layer after grinding of at least 6 mm composed of graded marble chippings in Portland, white or tinted cement on a base layer of fine concrete. They are machine ground after manufacture to expose the marble aggregate, and subsequently grouted.

Terrazzo precast slabs should conform to BS 4357.

2.3 Natural stone

Natural stones suitable for flooring and their surface finishes are as follows:

- a) granite: polished, eggshell, honed, fine rubbed, fine axed, dolly pointed, bush hammered, flame textured, air abrasive blasted or tooled;
- b) marble, travertine and hard limestone: polished, eggshell, honed or gritted;
- c) slate: fine rubbed, sawn, riven or flame textured.
- d) quartzite: riven;
- e) limestone: fine rubbed, sawn or tooled;
- f) sandstone: fine rubbed, sawn, tooled or riven.

Natural stone flooring units are available in various sizes and thicknesses. The material selected will govern the required thickness for a unit of any given size. Units up to 0.6 m² in superficial area may be fixed by the methods described in this code. Larger units may require different bedding procedures.

Slate should be either type A or B as described in clause 19 of BS 5642-2:1983 and should conform to the test requirements given in clause 23 of BS 5642-2:1983.

NOTE Slate is classified as determined by the sulfuric acid immersion test; type A being suitable for areas of high air pollution whilst type B is suitable for areas of slight to moderate air pollution.

2.4 Composition block

Composition blocks are proprietary materials. A typical block is a mixture of cement, wood granules, mineral fillers, pigments and water, moulded under high pressure, cured and then saturated with linseed oil.

Composition blocks should be uniform throughout their thickness.

Most composition blocks are oblong, but square and other geometric shapes are available.

2.5 Cement

Unless otherwise stated the cements used should conform to BS 12 or BS 4027.

Portland cements and sulfate resisting cements having a number of strength classes are now available. Specifiers should select the class appropriate to the intended use.

High alumina cement conforming to BS 915 may be used for particular purposes but it should not be mixed with other types of cement.

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

2.6 Lime

Lime should conform to BS 890 and should be properly hydrated or slaked.

Lime may be measured either as putty prepared from quicklime, hydrated lime or by-product lime, or as dry hydrated lime; equal volumes of the lime putty and the dry hydrated lime are regarded for practical purposes as containing the same amount of lime.

2.7 Sand

Sand for cement : sand screeds and mortar beds should conform to grading C or M in Table 4 of BS 882:1983.

NOTE For sand for grouts see 2.14.2.

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

2.8 Water

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

2.9 Adhesives

The types of adhesive recommended as beds for the flooring units in this code are:

- a) *cement-based adhesives* (hydraulically-hardening mortars);
- b) *organic-based adhesives* (dispersion, dispersion/cement, dissolved resin and reaction resin adhesives).

These are proprietary materials and those selected should conform to BS 5980 and should be used in accordance with the manufacturer's instructions.

2.10 Admixtures

2.10.1 Admixtures for cement : sand mortar beds and screeds

Admixtures for cement : sand mortar beds and screeds should conform to the appropriate Part of BS 5075.

2.10.2 Admixtures for adhesives

Admixtures for adhesives may be a polymer additive or some other liquid or powdered product incorporated 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.

2.11 Reinforcement

Where light reinforcement is required in a screed or bed it should consist of steel fabric conforming to BS 4483:1985, reference D49 or D98.

Heavier reinforcement may be necessary in screeds constructed for structural purposes.

For reinforcement which does not have to provide a structural function, adequate tensile stresses can be absorbed by reinforcement of 2.5 mm or 5 mm diameter wire in mesh sizes of 50 mm × 50 mm, 100 mm × 100 mm, or 200 mm × 100 mm or 200 mm × 200 mm depending on screed or bed thickness.

2.12 Bonding agents

Bonding agents to improve the adhesion of screeds and/or beds to bases should be used in accordance with the manufacturer's instructions.

Manufacturers recommend particular grades and methods of application depending on the materials involved and service conditions, e.g. flooring in heavy duty areas, external applications.

2.13 Separating layers

2.13.1 Polyethylene film

A 500 gauge (0.125 mm) polyethylene film is recommended for most conditions.

2.13.2 Building paper

Building paper should be selected from those specified in BS 1521.

2.13.3 Bituminous felt

Bituminous felt should be selected from those specified in BS 747.

2.14 Grout materials

2.14.1 General

Grout materials should have good working characteristics, low shrinkage and good adhesion to the sides of the joints. Additional properties may assume special importance, for example, impermeability; resistance to water, heat, cleaning agents and chemical attack; resistance to mould growth and bacteria; resilience and compressibility. Flexibility of joint materials is given in Table 1.

Proprietary grout materials should be stored and used in accordance with the particular manufacturer's instructions.

Table 1 — Flexibility of joint and sealant materials

Materials	Flexibility
<i>Joint materials:</i>	
Portland cement mortar	Rigid
High alumina cement mortar	Rigid
Rubber latex cement	Slightly resilient
Furane resin	Rigid and tough
Epoxide resin	Rigid and tough
<i>Sealant materials:</i>	
Bitumen compounds	Plastoelastic
Polysulfide	Very resilient
Silicone	Very resilient
Polyurethane	Very resilient
Epoxy/polysulfide	Slightly resilient

2.14.2 Sand for grout

For joints of nominal widths 6 mm and above, the sand for grout should conform to the grading limits of type B of Table 1 of BS 1199:1976.

For joints of nominal widths 3 mm to 6 mm, sands should lie within the grading limits given in Table 2. Sand conforming to 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 — Sands for grout for joints 3 mm to 6 mm wide

BS 410 sieve	Percentage by mass passing BS sieves
mm	%
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

2.14.3 Pigments

Pigments should be inorganic and compatible with the grouting materials.

Pigments for cement : sand or cement-based grouts should conform to BS 1014.

NOTE Coloured grouts cannot be expected to retain their pristine colour and appearance after wear.

2.15 Sealants and back-up materials for movement joints

Guidance on the selection and application of sealants is given in BS 6213. Suitable materials for movement joints in flooring are included in Table 1. The selection of the most suitable materials will depend upon design considerations (see section 3) and the manufacturer's advice should be taken into account.

Back-up materials 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, and cork boards. These materials are available in strip form.

2.16 Pre-formed strips

Pre-formed strips are suitable for use in stress-relieving or compression joints where a watertight seal is not critical. Materials such as cork, cork/rubber compounds, rubber/bitumen strips are suitable for use in light traffic areas. Materials such as PVC, or synthetic rubber strips are suitable for use in more heavily trafficked areas.

Section 3. Design

3.1 General

In solid and suspended floor constructions the stability and durability of the floor depend on the following:

- a) the load it has to support;
- b) the resistance it offers to the passage of liquid water or water vapour either from above or from below;
- c) size changes produced by variations in moisture content and temperature within the floor and the attack of various corrosive agents, e.g. in chemical plants and industrial premises.

The floorings dealt with in this code could also be affected by the preceding factors, and the relative importance of these factors should therefore be assessed at the design stage so that due allowance may be made for their possible effect on the finished floor.

When possible, selection of the type of flooring including its bed should be made at the structural design stage so that the appropriate depth can be allowed between the base and the finished floor surface. The variety of thicknesses in and between flooring units and beds is considerable (see **3.10**).

The designer should satisfy himself that the flooring proposed is suitable for the conditions contemplated. For example stones for flooring vary in their thickness according to the type of stone; the anticipated loading likely to occur and the size of the units used should also be considered.

3.2 Load considerations

When a floor is designed, due allowance should be made for the ultimate load it may have to support, including the flooring installation, and reference should be made to BS 6399-1. Where an existing floor is to be covered by the materials dealt with in this code a check should be made to ensure that the floor is sufficiently strong and rigid to accept the added load, particularly if the floor is of timber construction.

3.3 Bases

3.3.1 General

Concrete and cement : sand screeds are the most common bases over which the floorings dealt with in this code will be laid but other bases may be encountered, e.g. timber and asphalt. In refurbishing work, it may sometimes be necessary to apply new finishes over old floors such as ceramic tiles, terrazzo, granolithic, stone, etc. Before the flooring is laid it is essential that:

- a) the correct falls have been incorporated in the base, where required;

- b) the base is free from contamination, loose areas and significant cracks;

- c) the base is true to the specified plane (see also **4.1.4**).

Bases suitable to receive flooring and the beds recommended in each case are summarized in Table 3.

In new work it is necessary to specify the plane of the base in relation to that of the finished floor surface; usually this is possible only if the flooring units and the appropriate beds are selected at the design stage. The level of the base surface in relation to the finished floor surface should be such that the bed can be of the recommended thickness uniformly throughout the installation. An exception can be made when using a semi-dry mix bed as this can be applied in varying thicknesses, subject to the minimum of 25 mm, to overcome irregularities and to form falls. The recommended maximum and minimum final thicknesses of beds and their suitability under different floorings are given in Table 4.

In refurbishing work the new floor surface may be higher than the original and the effect on existing features such as channels, outlets, skirtings, doorways etc. should be considered.

Where a separating layer is to be interposed between the base and the bed it is important that the base is accurately formed and has a true and smooth surface to enable the bed to slide freely over the base in the event of differential movement.

3.3.2 Concrete

3.3.2.1 Surface finish

When floor units are bedded directly to a concrete base without a screed, the concrete should be struck off level with a straightedge and the surface texture closed. When a bonded bed is required laitance should be removed by mechanical means. To receive a cement : sand bonded bed, the prepared concrete surface should be wetted down for several hours prior to the application of the bed. When a separating layer is to be interposed between the bed and a concrete base, the surface of the latter should be free of ridges or steps that would impair the sliding action between the two elements.

3.3.2.2 Tolerances on levels and surface regularity

Tolerances on levels and surface regularity are given in **C.1.7** of Part 3 of BS 5385:1989.

Table 3 — Suitability of flooring beds for different bases

Base	Cement : sand mortar and cement : lime : sand mortar bonded to the base	Cement : sand semi-dry mix		Adhesives
		Bonded	Unbonded ^a	
New concrete (less than 6 weeks old)	U	U	S	U
New screed (less than 3 weeks old)	U	U	S	U
Mature concrete	S	S	S	S
Mature screed	S	S	S	S
Screed over suspended floor or underfloor heating	U	U	S	C
Suspended in situ concrete				
Rigid and new (less than 6 weeks old)	U	U	S	U
Rigid and mature	S	S	S	S
With significant deflection	U	U	S	C
Timber	U	U	U	C
Asphalt	U	U	S	C
Existing hard floor finishes after preparation				
Terrazzo	S	U	S	C
Unglazed ceramic tile	S	S	S	S
Glazed ceramic tile	S	U	S	C
Granolithic topping	S	S	S	S
Natural stone	S	S	S	S
Key S Suitable U Unsuitable C Confirm suitability with tile manufacturer or supplier ^a Unbonded beds are unsuitable for heavy traffic conditions but see 3.4.2.				

3.3.2.3 Elimination of construction moisture

Structural concrete should have been subjected to continuous air drying after the end of curing for at least 6 weeks before either a screed or bed is applied. The same allowance should be made for concrete with an integral screed surface. A longer period may be necessary in wet weather.

3.3.3 Screeds

A screed is often used as an intermediate layer between the structural base and bed to provide a true and even surface on which to apply a finish. Recommendations for the design and laying of screeds is given in appendix C of Part 3 of BS 5385:1989.

3.3.4 Timber bases

NOTE See 3.2 for load considerations.

New timber bases should be designed not merely to carry the additional dead load but also to provide a stiff floor. The limit of deflection permitted in BS 5268-2 may be too great to avoid damage to a rigid finish and its bed.

New timber bases should have noggings between the joists at 300 mm centres. The surface provided for tiling should be exterior-grade plywood of a minimum thickness of 15 mm screwed to both joists and noggings at intervals of a maximum of 300 mm. The lower face and edges of plywood should be sealed against the ingress of moisture before being screwed down. All junctions between boards should be supported by noggings or joists.

The design should take into account the initial drying shrinkage of the timber and subsequent movements due to moisture changes, bearing in mind the type of heating for the building.