

BS 5385-4:2015



BSI Standards Publication

Wall and floor tiling – Part 4: Design and installation of ceramic and mosaic tiling in specific conditions – Code of practice

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Summary of pages

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Foreword

Publishing information

This part of BS 5385 is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 31 October 2015. It was prepared by Technical Committee B/539, *Ceramic tiles and other rigid tiling*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This part of BS 5385 supersedes BS 5385-4:2009, which is withdrawn.

Information about this document

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

- updated references to take account of the new harmonized European product standards and their supporting suites of test methods.

This part of BS 5385, *Wall and floor tiling* is one of a series dealing with the installation of floor and wall tiling, the other parts being:

- Part 1: Design and installation of internal ceramic, natural stone and mosaic wall tiling in normal conditions – Code of practice
- Part 2: Design and installation of external ceramic and mosaic wall tiling in normal conditions – Code of practice
- Part 3: Design and installation of internal and external ceramic and mosaic floor tiling in normal conditions – Code of practice
- Part 5: Design and installation of terrazzo, natural stone, agglomerated stone tile and slab flooring – Code of practice

Use of this document

As a code of practice, this part of BS 5385 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 5385 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 5385 gives recommendations for the design considerations and installation of ceramic wall and floor tiling and mosaics in situations where there are specific functional, e.g. sterile conditions, or environmental requirements, e.g. wet areas, and conditions that are potentially detrimental, e.g. chemical attack, to either or both the installation or the background. Recommendations are given for the choice of materials, application practices and, where appropriate, for the design of backgrounds and structural bases.

This part of BS 5385 augments the recommendations given in BS 5385-1, BS 5385-2 and BS 5385-3.

NOTE BS 5385-1, BS 5385-2 and BS 5385-3 give recommendations for internal and external, wall and floor tiling and mosaics for exchanging information, time schedules, suitable materials, tile backgrounds and bases and their preparation, cement and sand rendering, movement joints, bedding methods for tiles and mosaics, grouting, protection, cleaning and maintenance.

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 5385-1, *Wall and floor tiling – Part 1: Design and installation of internal ceramic, natural stone and mosaic wall tiling in normal conditions – Code of practice*

BS 5385-2:2014, *Wall and floor tiling – Part 2: Design and installation of external ceramic and mosaic wall tiling in normal conditions – Code of practice*

BS 5385-3:2014, *Wall and floor tiling – Part 3: Design and installation of internal and external ceramic and mosaic floor tiling – Code of practice*

BS 5493, *Code of practice for protective coating of iron and steel structures against corrosion*

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

BS 6349-1, *Maritime structures – Part 1: Code of practice for general criteria*

BS 8204-1, *Screeds, bases and in-situ floorings – Part 1: Concrete bases and cementitious levelling screeds to receive floorings – Code of practice*

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

BS EN 12002:2008, *Adhesives for tiles – Determination of transverse deformation for cementitious adhesives and grouts*

BS EN 12004:2007+A1:2012, *Adhesives for tiles – Requirements, evaluation of conformity, classification and designation*

BS EN 12620, *Aggregates for concrete*

BS EN 13888:2009, *Grouts for tiles – Requirements, evaluation of conformity, classification and designation*

BS EN 14411:2012, *Ceramic tiles – Definitions, classification, characteristics, evaluation of conformity and marking*

NA to BS EN 1992-3, *UK National Annex to Eurocode 2: Design of concrete structures – Part 3: Liquid retaining and containment structures*

3 Terms and definitions

For the purposes of this part of BS 5385, the terms and definitions given in BS 5385-1, BS 5385-2, BS 5385-3, BS 6100-6 and BS EN 14411 and the following apply.

3.1 salt water

all types of saline water such as medicinal spa water, used in swimming and hydrotherapy pools, and seawater

3.2 chemical attack

that which occurs when certain materials in tile installations are affected by chemical reaction

NOTE For example, when cementitious bedding and joint filling materials are attacked in acidic conditions.

3.3 mildly corrosive situations

situations in which the corrosive substance is of low concentration, or is only mildly aggressive by nature, or is promptly removed after spillage

3.4 highly corrosive situations

situations in which the corrosive substance is highly aggressive, especially if it is likely to remain in contact with the tiling for long periods

4 General

COMMENTARY ON CLAUSE 4

The conditions covered in this part of BS 5385 fall into two groups:

a) Conditions to be resisted (see Clause 5 to Clause 10):

- *movement (see Clause 5);*
- *traffic and load conditions (see Clause 6);*
- *wet and damp conditions (see Clause 7);*
- *chemical attack (see Clause 8);*
- *thermal effects (climatic and environmental) (see Clause 9);*
- *contamination from radioactivity (see Clause 10).*

b) Conditions to be achieved (see Clause 11 to Clause 14):

- *sterile conditions (see Clause 11);*
- *thermal insulation (see Clause 12);*
- *sound insulation (see Clause 13);*
- *anti-static conditions (see Clause 14).*

For situations where several conditions are present the design specification should be directed towards achieving the most important function required of the system. In some cases a compromise solution might be found for meeting conflicting needs, but this should not be undertaken if its adoption is likely to place the durability of the installation at risk.

Design specifications should meet the most exacting conditions that could be imposed on the installation, even though these might not be sustained and might occur infrequently.

Slip resistance and cleaning should be considered at the design stage.

NOTE 1 Guidance on these subjects is given in Clause 15 and Annex A.

If an installation is subjected to change of use, introducing conditions different from those originally foreseen, a careful check of the installation should be made to assess its degree of suitability.

NOTE 2 Classes of tiles suitable for use in specific conditions are given in Table 1 for wall tiling and Table 2 for floor tiling.

NOTE 3 Suitability of bedding methods for use in specific conditions are given in Table 3 for walls and in Table 4 for floors.

Recommendations given in Table 1, Table 2, Table 3 and Table 4 regarding suitability should be read only in conjunction with the specified clauses.

NOTE 4 Resistance of tile bed, grout and sealant materials to various liquids are given in Table 5.

As some adhesives and jointing materials emit odours during curing that might adversely affect foodstuffs and other materials and/or cause discomfort to occupants, the manufacturer's instructions should be closely followed.

Table 1 Suitability of ceramic tiles for internal wall tiling in specific conditions

Specific conditions		Product group as classified in BS EN 14411:2012, Table 1					Clause reference
		AI _a BI _a <0.5%	AI _b BI _b 0.5% to 3%	AI _a BI _a 3% to 6%	AI _b BI _b 6% to 10%	AI _{III} BI _{III} >10%	
Impact		S	S	S	C	C	6.3
Wet and damp conditions	installations subject to occasional wetting	S	S	S	S	S	7.2.3
	installations continuously immersed	S	S	S	U	U	7.3
Chemical attack	installations subject to frequent wetting	S	S	S	C	C	7.2.4
	mildly corrosive conditions	C	C	C	C	C	8.4.2
	highly corrosive conditions	C	C	C	C	C	8.4.3
Sterile conditions		S	S	S	C	S	11
Thermal effects (climatic and environmental)		S	S	S	C	C	9
Thermal insulation		S	S	S	S	S	12
Sound insulation		S	S	S	S	S	13
Radioactivity		C	C	C	U	U	10
S - Suitable							
U - Unsuitable							
C - Confirm tiles' suitability with the manufacturer							

Table 2 Suitability of ceramic tiles for internal floor tiling in specific conditions

Specific conditions		Product group as classified in BS EN 14411:2012, Table 1					Clause reference
		AI _a BI _a <0.5%	AI _b BI _b 0.5% to 3%	AI _{IIa} BI _{IIa} 3% to 6%	AI _{IIb} BI _{IIb} 6% to 10%	AI _{III} BI _{III} >10%	
Impact	light to moderate loads and impact	S	S	S	S	U	6.1
	heavy loads and impact	C	C	C	C	U	6.1
Wet and damp conditions	installations subject to occasional wetting	S	S	S	S	C	7.2.3
	installations continuously immersed	S	S	C	U	U	7.3
	installations subject to frequent wetting	S	S	C	C	U	7.2.4
Chemical attack	mildly corrosive conditions	C	C	C	C	C	8.4.2
	highly corrosive conditions	C	C	C	C	C	8.4.3
Sterile conditions		S	S	C	C	C	11
Thermal effects (climatic and environmental)		S	C	C	C	C	9
Thermal insulation		S	S	S	C	C	12
Sound insulation		S	C	C	U	U	13
Radioactivity		S	C	U	U	U	10

S - Suitable
U - Unsuitable
C - Confirm tiles suitability with the manufacturer

Table 3 Suitability of bedding methods for wall tiling in specific conditions

Specific conditions		Bedding methods			Dispersion adhesives	Clause reference
		Cementitious adhesives	Reaction resin adhesives			
Impact		S	S		C	6.3
Wet and damp conditions	installations subject to high humidity and occasional wetting	S	S		C	7.2.2 and 7.2.3
	installations continuously immersed	C	C		U	7.3
	installations subject to frequent wetting	S	S		C	7.2.4
Chemical attack	mildly corrosive conditions	C	C		C	8.4.2
	highly corrosive conditions	U	C		U	8.4.3
Sterile conditions		S	S		C	11
Thermal effects (climatic and environmental)		C	C		C	9
Thermal insulation		S	C		S	12
Sound insulation		S	C		S	13
Radioactivity		S	S		S	10
S - Suitable						
U - Unsuitable						
C - Confirm tiles' suitability with the manufacturer						

Table 4 Suitability of bedding methods for floor tiling in specific conditions

Specific conditions		Bedding methods		Clause reference
		Cementitious adhesives	Reaction resin adhesives	
Traffic and load conditions	light to moderate loads and impact	S	S	6
	heavy loads and impact	S ^{A)}	S	6
Wet and damp conditions	installations subject to high humidity and occasional wetting	S	S	7.2.2 and 7.2.3
	installations continuously immersed	S	C	7.3
	installations subject to frequent wetting	S	S	7.2.4
Chemical attack	mildly corrosive conditions	S	C	8.4.2
	highly corrosive conditions	U	C	8.4.3
Sterile conditions		S	S	11
Thermal effects (climatic and environmental)		C	C	9
Thermal insulation		S	S	12
Sound insulation by methods in 13.2 a) and b)		C	C	13.2
On thick screed over a sound-absorbent layer		S	S	13.2
Electrostatic conditions		S	S	14
Radioactivity		S	S	10

S - Suitable

U - Unsuitable

C - Confirm tiles' suitability with the manufacturer

^{A)} Cementitious adhesives modified with resilient fillers might have reduced impact resistance.

5 Movement

5.1 General

NOTE Stresses could be created in the tiling system as a result of movement due to factors such as drying shrinkage (see 5.2) and moisture movement (see 5.3) in the background and thermal and moisture changes in the tiling. These stresses, if not properly controlled, can sometimes be sufficient to promote loss of adhesion and bulging or cracking of the tiling. There are also sources of movement external to the tiling system that might affect the tiles themselves, e.g. settlement and subsidence of buildings, vibration and lift shafts and machinery. Settlement, subsidence and vibration are uncommon sources of trouble, but where the stresses they promote are considerable, wall and floor tiling are likely to be affected.

No precautions can be taken at the time of tiling to eliminate the effects of settlement and subsidence but the use of a deformable adhesive can be beneficial in reducing the effects of vibration and specialist advice should be sought. With other sources of movement, there are positive steps that should be taken to reduce the risk of tiles being damaged during their service life.

5.2 Drying shrinkage movement

Drying shrinkage movement of backgrounds is the most common source of movement in tile installations and it is important that new constructions should be allowed to dry out before tiles are fixed. Minimum drying times in accordance with BS 5385-1, BS 5385-2 and BS 5385-3 should be followed.

NOTE The times given might require considerable extension depending on the site conditions, thickness and mass of the structure.

Longer drying times should be given for concrete pools and tanks (see 7.3.2).

5.3 Moisture movement

COMMENTARY ON 5.3

Porous materials can absorb moisture from the atmosphere and might expand as a result. Conversely, some porous materials contract when they dry out. When these changes are small, they do not create problems, but if the size changes are appreciable and ceramic tiles are fixed to such backgrounds, the tiling will be subjected to stress and some loss of adhesion or cracking can result.

5.3.1 Walls

Backgrounds of porous materials having appreciable moisture movements should be thoroughly dry before fixing commences. If these backgrounds are rendered or plastered, at least a further two weeks and four weeks respectively should be allowed for drying.

Movement joints should be provided where necessary in accordance with 5.7 and 6.6.

The walls of premises that are closed for appreciable periods in winter and have no space heating might become damp and expand; in extreme conditions such premises are liable to frost damage and should have provision for automatic heating.

5.3.2 Floors

NOTE Moisture movement is unlikely to be a factor in mature sub-floors of concrete or screeded concrete construction.

As timber sub-floors are prone to distortion as a consequence of moisture absorption, they should be avoided where their use is detrimental to the installation (see BS 5385-3).

5.4 Moisture movement (long-term expansion)

NOTE In common with most porous ceramic materials, tiles with water absorptions more than 3% could expand slightly as a result of the gradual uptake of moisture irrespective of the level of dampness in the installation. Where water absorption is less than 3%, tiles have negligible expansion.

The fixing methods and the provision of expansion joints recommended in this standard should be followed in order to accommodate long-term expansion.

5.5 Thermal movement

Where thermal movement in tiling occurs, the recommendations in 12.4 should be followed.

5.6 Vibration

Where vibration, from machinery located on or adjacent to walls for example, is likely to subject wall tiling to small but constant movement, a deformable adhesive classified S1 or S2 in accordance with BS EN 12002:2008, should be used to fix the tiles.

NOTE 1 Where vibration affects floor tiling an S1 or S2 classified adhesive laid onto an unbonded screed can be used or the semi dry mix method or the separating layer method, incorporating an adhesive slurry bonding coat, might be used.

The area subject to vibration should be isolated from adjacent static areas.

NOTE 2 S2 classified adhesives and unbonded screeds are not suitable in heavily trafficked floor areas.

5.7 Movement joints

Stresses in wall and floor tile installations should be controlled by incorporating adequate movement joints (see 6.6). Unless recommendations specific to tiling in specific conditions are given in this part of BS 5385 for materials, design and location of the movement joints, reference should be made to one of the following:

- a) internal wall tiling: BS 5385-1;
- b) external wall tiling: BS 5385-2;
- c) floor tiling: BS 5385-3.

6 Traffic and load

6.1 General

For floor tiling subject to light traffic only, i.e. low density pedestrian and lightweight soft-wheeled vehicular traffic, the recommendations in BS 5385-3, including solid bedding, should be followed.

Pedestrian traffic of high density, heavy vehicular traffic and the dragging of heavy objects and loads can result in damage due to dynamic and static loading, impact and abrasion; this can be severe and further precautions should be taken. The additional resistance to damage should be achieved by solidly bedding sufficiently thick ceramic tiles directly to a structural concrete or sound cement and sand screed.

Where tiles are to be bedded on a cement and sand screed, the screed should be suitable for the anticipated load and be tested for soundness in accordance with BS 8204-1. In the area in which the screed is tested, 90% of all indentations should be category A, i.e. a maximum depth of 3 mm.

Materials and the method of application should be selected to resist the most arduous conditions likely to be imposed on the tiling, no matter how infrequently, during the life of the installation.

6.2 Dynamic and static loading

6.2.1 General

Compressive forces are exerted by dynamic and static loading and by some kinds of impact; to reduce the incidence of damage from these forces there should be no voids within the system.

6.2.2 Floor tiling

COMMENTARY ON 6.2.2

Severe loading arises from high-density pedestrian and heavy vehicular traffic (dynamic) and from heavy standing loads and objects (static).

Vehicular traffic is essentially of two types, heavy vehicles with pneumatic tyres and trolleys and forklift trucks with small wheels generally with solid tyres.

The loads exerted by moving vehicular traffic at constant speed on level surfaces are the same as the static loads which the vehicles at rest exert. The highest loads under moving traffic occur from bouncing on uneven surfaces. An adequate safety margin for ceramic flooring is advised.

The most severe stresses are exerted by small hard-rimmed wheels, and the harder the rim, the smaller the area of contact and, therefore, the greater the static load.

Acceleration and deceleration of heavy vehicles with pneumatic tyres exert little additional load on floors because the speed is usually low.

In situations where heavy loads are involved, especially when carried by vehicles with hard-rimmed wheels, the strength of the floor is improved by the use of the denser and thicker types of tile. Damage can arise from the bouncing and gouging of hard wheels, especially metal-shod wheels; the smaller the wheels, the greater the risk.

Tiles should be chosen of different thicknesses, each appropriate to the operations and traffic load in a given area.

In areas where only vehicles with pneumatic tyres are used, it is possible to lay floor tiles with relief surfaces in order to provide improved slip-resistance. Generally, however, for vehicular traffic areas and always for areas carrying vehicles with hard-rimmed wheels, the tiles should have plane or low-relief surfaces. Tile joints should be solidly filled with grout as far as practicable.

NOTE 1 The suitability of classes of floor tiles and bedding methods for different conditions is given in Table 2 and Table 4 respectively.

In all cases the structural base should be dense concrete and it is important that this is strong, rigid and allowed to mature after curing for at least 6 weeks before a screed or tiling by direct bedding is applied.

NOTE 2 A longer drying period might be necessary in poor drying conditions.

NOTE 3 Sub floors constructed using insulation boards of low density such as expanded polystyrene are not suitable in situations of extremely high dynamic and static loading.