



CP 202 : 1972

UDC 693.74/76 : 69.025.3

Code of Practice for
**Tile flooring and
slab flooring**

Gr. 7

British Standards Institution



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First published June, 1951

First revision March, 1959

Second revision December, 1972

ISBN: 0 580 075508

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The following BSI references relate to the work on this Code of Practice:
Committee reference BLCP/16 Draft for comment 67/2 1394

Code Drafting Committee BLCP/16, Tiling (Walls and Floors)

Mr. R. G. Cole *Chairman*

Mr. A. Dinsdale

Mr. R. G. Cole

Mr. A. Ford

Mr. J. Fryer

Mr. S. B. Johnson

Mr. R. S. Maddock

Mr. A. Vaughan

Mr. F. Vaughan

Mr. G. Whalley

Mr. S. Cartwright

Mr. T. H. Barnwell

Mr. D. Maxted Jones

Mr. B. W. Shacklock

Mr. W. J. Warlow

Mr. J. D. S. Wilkie

Mr. J. Stockall

Mr. V. Vohralik

Mr. A. S. W. Abell

Mr. J. Sambrook

Mr. R. A. Adams

Mr. R. S. Reynolds

Mr. P. A. James

Mr. R. E. Cramp

Mr. D. A. Slade

Mr. F. W. H. Bird

Mr. R. J. Rogers

Mr. H. J. Bunn

Mr. F. Levi

Mr. J. S. Vulliamy

Mr. R. Woolman

Mr. G. Fairweather

Mr. R. Kirby

British Ceramic Research Association

British Ceramic Tile Council

British Precast Concrete Federation

British Rubber and Resin Adhesive Manufacturers' Association

British Stone Federation

Cement and Concrete Association

Department of the Environment, Building Research Establishment

English Slate Quarries Association

Federation of British Rubber and Allied Manufacturers

Federation of Master Builders

Floor Quarry Association

Granite and Marble Association

Institute of Clerks of Works of Great Britain, Inc.

National Federation of Plastering Contractors

National Federation of Terrazzo-Mosaic Specialists

National Master Tile Fixers' Association

National Tile, Faience and Mosaic Fixers' Society

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Sealant Manufacturers' Conference

Nominated by BLCP/-

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CP 202 : December 1972

UDC 693.74/75 : 69.025.3

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Amendments issued since publication

Amd. No.	Date of issue	Text affected

CP 202 : 1972

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This Code of Practice represents a standard of good practice. Compliance with it does not confer immunity from relevant statutory and legal requirements.

Foreword

This Code has been prepared by a reconstituted Code Drafting Committee to cover a wider range of floor tiling units and to take account of improvements in fixing techniques. Because of experience the Committee no longer recommend the use of the sand separating layer with tiled floors. They have, however, introduced into the Code the sand and cement semi-dry mix method of bedding tiles.

In accordance with the change to the metric system this Code gives values in terms of SI units. For further information on SI units reference should be made to BS 3763, 'The International System of units (SI)' and PD 5686, 'The use of SI Units'.

British Standard Code of Practice

Tile flooring and slab flooring

1. General

1.1 Scope

This Code of Practice deals with all work involved in the laying of clay floor tiles, concrete tiles, terrazzo tiles and slabs, brick floors, stone floors (both natural and cast, including marble, granite, quartzite and slate) and asphalt tiles bedded on a solid base.

Mosaic tiles constitute a specialized form of flooring and require particular treatment in some aspects of fixing. These aspects are not dealt with in this Code but the general principles of the Code apply.

NOTE. The titles of the British Standards and Codes of Practice referred to in this Code are listed on the inside back cover.

1.2 Definitions

For the purposes of this Code the following definitions apply:

- (1) *Base.* The material on which bedding or the separating layer is laid (see 3.1.6 and Fig. 1).
- (2) *Bedded finish.* The tile or slab finish including its bedding (see Fig. 1).
- (3) *Bedding.* A layer of specified materials in which the tile or slab is set (see Fig. 1).
- (4) *Damp-proof membrane.* A continuous layer of impervious material to resist the passage of moisture (see Fig. 1).
- (5) *Grout.* A material worked into the normal joints between tiles or slabs (see Fig. 1). With terrazzo, the term also includes material similar to that used in the wearing surface layer and is applied after surface grinding has taken place, to fill any voids in the wearing layer before the final polishing operation.
- (6) *Joint.* A space between the edges of adjacent tiles or slabs (see Fig. 1).
- (7) *Movement joint.* A joint, usually wider than the normal joint between tiles and/or slabs, designed to accommodate lateral movement in the base or bedded finish and which is filled with materials having special properties (see 2.11 and 3.3).
- (8) *Screed.* A layer of material of defined minimum thickness, which may be interposed between the structural base and the bedded finish. (see 3.1.7 and Fig. 1).
- (9) *Separating layer.* A layer of material which isolates the base from the bedded finish (see Fig. 1).
- (10) *Tiles and slabs.* There is no clear dividing line between tiles and slabs but units having an area of approximately 0.28 m^2 and which are at least 25 mm thick are generally termed slabs. Clay tiles generally do not exceed approximately 0.05 m^2 in area.

1.3 Exchange of information

There should be consultation, preferably early in the design stage, between all parties concerned with the work. Information to be exchanged will include whichever of the following are applicable:

- (1) *Site.* Location, access, unloading and storage facilities.
- (2) *Building.* Nature of building, assessment of type and density of traffic, particulars of corrosive or other potentially damaging conditions.
- (3) *Floor.* Structural floor, type of damp-proof membrane and its location within the floor construction, nature of screed, curing and drying times, particulars of any floor warming installation, separating layer, bedding and jointing materials, finished floor levels and falls with permissible deviations.

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(4) *Associated work.* Services embedded in or passing through the floor, skirtings and abutments, junctions with other adjacent floorings.

(5) *Finishes.* Dressing and surfacing, method of and responsibility for protection of completed work.

(6) *Contract.* Particulars of the form and type of contract, if the work is to be completed in any specific order or in sections, safeguarding against damage or theft, safety and health provisions, welfare facilities, lighting and power supply.

(7) *Time schedule.* A time schedule for the progress of the work.

2. Materials

2.1 Tiles

2.1.1 Clay tiles. Clay floor tiles and floor quarries should comply with the requirements of BS 1286.

The designer should satisfy himself that the clay floor tiles and floor quarries are suitable for the conditions contemplated.

2.1.2 Concrete tiles. Concrete tiles should comply with the requirements of BS 1197, Part 2. Concrete tiles usually have a wear layer at least 6 mm thick on a backing of fine concrete but in some cases the same concrete mix is used throughout the full thickness.

The composition of the wear layer ranges from fine pigmented mixes designed primarily to give decorative effects, to coarser mixes designed to give good abrasion resistance by the use of hard-wearing natural or manufactured aggregates.

The designer should satisfy himself that the concrete tiles proposed are suitable for the conditions contemplated.

2.1.3 Terrazzo tiles and slabs. Terrazzo tiles should comply with the requirements of 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. Slip-resisting grits may be incorporated.

Terrazzo precast slabs should comply with the requirements of BS 4357.

The designer should satisfy himself that the terrazzo tiles or slabs proposed are suitable for the conditions contemplated.

2.1.4 Mosaics. These offer a variety of shapes and sizes. As there is at present no British Standard for these materials, it is recommended that before selecting a particular flooring system, the advice of the suppliers of the mosaic should be obtained as to the suitability of the particular mosaics to the conditions of use.

2.2 Bricks for flooring

In selecting a brick for flooring the advice of the suppliers should be sought. Special paving-bricks with or without a chequered surface can be obtained. Clay building bricks should conform to the requirements of BS 3921, Part 2 and concrete bricks to BS 1180.

Acid-resisting bricks and tiles (not quarries) should comply with the requirements of BS 3679.

2.3 Natural stone

The range of natural stone for flooring is wide and the designer should satisfy himself that the stone flooring is suitable for the conditions contemplated. Natural building stones may be classified as:

- (1) granite and other igneous rocks;
- (2) limestone, including marble;
- (3) sandstone, including quartzites;
- (4) slate, (see BS 680, Part 2).

Paving slabs vary in thickness according to their required use and the type of stone. Natural flagstones may be made from any fine-grained rock that splits readily along the cleavage plane.

2.4 Cast stone

Cast stone should comply with the requirements of BS 1217. It has been described as reconstructed stone, artificial stone; in this Code the term 'cast stone' is used. Most varieties of natural stone may be crushed and graded to make the aggregate.

2.5 Asphalt tiles

Asphalt tiles for paving and flooring should comply with the requirements of BS 1324.

2.6 Bedding and jointing materials

2.6.1 Cement The cement used should generally be ordinary or rapid-hardening Portland cement complying with the requirements of BS 12. Other cements such as sulphate-resisting Portland cement complying with the requirements of BS 4027 and high alumina cement complying with the requirements of BS 915 may be used for particular purposes. Unless otherwise stated the recommendations in this Code refer to cement complying with the requirements of BS 12.

Attention is drawn to the advisability of using cement in accordance with the manufacturer's recommendations.

High alumina cement 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 has deteriorated should not be used.

2.6.2 Lime. Lime should comply with the requirements of BS 890 and should be properly hydrated or slaked (see CP 221).

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.

2.6.3 Sand. Sand stocks should be protected from the weather to ensure that they are reasonably dry, clean and not affected by frost.

Sand or crushed rock for the bedding mix should be clean, moderately sharp, not too fine, and free from clay, organic and soluble matter, and should not be allowed to become contaminated. Suitable aggregate may be obtained from those complying with the requirements of BS 882 (grading zones 1 to 3).

2.6.4 Cement-based adhesives. Cement-based adhesives are proprietary materials and where used should conform to the requirements of Appendix B of CP 212, Part 1.

2.6.5 Bitumen emulsion. Bitumen emulsion should be in accordance with the requirements of BS 3940, Type 6.

2.6.6 Other bedding and jointing materials. Other bedding and jointing materials referred to in Table 1 should be stored and used in accordance with the particular manufacturer's instructions.

2.7 Water

Water should be fresh and clean. All containers used for storing or carrying water or for soaking tiles should be clean. Attention is drawn to BS 3148.

2.8 Battens for tiling

Battens should be true and equal to the combined thickness of the tile and fixing bed. Straight edges should be plane and true.

2.9 Separating layer

2.9.1 Bituminous felt. Bituminous felt should be selected from those specified in BS 747, Part 2, Class 1.

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

2.9.3 Polythene film. A 500 grade film is recommended for most conditions.

2.10 Pigments

Any pigments incorporated in mortar for pointing should conform to the requirements of BS 1014.

In order to achieve the best staining power and homogeneity pigments should be milled in with the dry cement before adding to the mix, or alternatively, coloured cement should be used, as supplied by the cement manufacturer.

2.11 Sealants, back-up materials and fillers for movement joints

2.11.1 Sealants. Suitable materials for movement joints in floor tiling are listed in Tables 1 and 2. The selection of the most suitable sealant will depend upon design considerations, (see 3.3) and the manufacturer's advice should be taken into account.

2.11.2 Back-up materials and fillers. Back-up materials are used to control the depth of sealant and the mode of deformation of the sealant. Fillers are used to fill the bulk of the joint and support the sealant. In some cases both functions are served by one material. The back-up and/or filler should be appropriate to the conditions of use, and should be compatible with the sealant used; suitable materials include expanded rubber, plastics such as cellular polyethylene, some fibreboards, caulking cotton and untarred oakum. Some materials may require an additional barrier such as polyethylene film to prevent the sealant sticking to the back-up or filler.

2.11.3 Pre-formed strip materials. These may be used in compression or stress relieving joints where watertightness is not critical. Suitable materials are cork, cork-rubber compositions, rubber bitumen compounds, PVC and hard synthetic rubber strips.

3. Design considerations

3.1 General

In solid and suspended floor constructions the stability of the floor is dependent on a number of factors, including the load it has to sustain, the resistance it offers to the passage of liquid water or water vapour either from above or from below, size changes produced by variations in moisture content and temperature within the floor and the attack of various corrosive agents e.g. in chemical plant and industrial premises. Any of the floors dealt with in this Code could also be affected by these same 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.

There are also special considerations which apply in particular circumstances, e.g. anti-static flooring in hospital operating theatres, where much can be accomplished by careful attention to detail at the design stage.

3.1.1 Load considerations. When a floor is designed due allowance should be made for the ultimate weight it may have to bear including the flooring installation, and reference should be made to CP 3, Chapter V, Part 1. The constructional weight will be increased where an existing floor is to be covered by the materials listed in Section 2 and advice should, therefore, be sought as to whether the floor is sufficiently strong and rigid to accept the added load particularly if the floor is of timber construction.

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 CP 112 may be too great to avoid damage to a rigid finish and its bedding.

Existing timber bases should be carefully examined to ensure that they can carry the additional dead load without excessive deflection and should, if necessary, be stiffened so as to give the required rigidity. It should also be established that ventilation is adequate and that effective damp-proof courses are correctly located. Timber floors of faulty construction have often behaved satisfactorily for a period of years as a result of surface evaporation of moisture. If this is hindered by the laying of a nearly impervious covering the moisture content may rise to a dangerously high level, thus creating conditions favourable to fungal attack (e.g. 'dry rot').

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

3.1.2 Passage of water through floors. Floors consisting of a concrete base and any of the floor finishes dealt with in this Code are not completely impervious to liquid water, nor do they offer substantial resistance to the passage of water vapour. It may therefore be expected that ground moisture and the water used in construction will be transmitted through solid floors by capillarity and by distillation to the air above, where it can evaporate to leave the floor surface apparently dry. Where the installation is in bathrooms, around shower trays etc. it may be necessary to incorporate some form of damp-proofing beneath the finished flooring.

3.1.2.1 Need for damp-resisting construction. In many situations, continuous transmission of water in this way is tolerable but account should be taken of the following possible effects, each of which may make it desirable to use some form of damp-resisting construction (see CP 102).

(1) *Evaporation.* Evaporation will be impeded by additional floor coverings less permeable than those discussed here or by fittings or stored goods in direct contact with the floor. Local dampness might consequently be so severe as to encourage moulds and to rot or corrode materials in contact with it.

(2) *Soluble salts.* Water passing through a solid floor is likely to contain soluble salts picked up from the sub-soil, the hard fill and the concrete of the floor itself. These will tend to accumulate in increasing concentration at or near the floor surface as long as they can be replenished from below. In the worst possible case, i.e. where the sub-soil or the fill is contaminated with acids or high concentrations of soluble sulphur compounds which attack cement, the safety of the whole floor may well depend on adequate damp-proofing below the base (see CP 102). In less aggressive situations, damp-proofing which serves only as a capillary barrier is still justified as a precaution against persistent efflorescence at the floor surface and possible attack on the concrete by small concentrations of sulphates.

(3) *Efflorescence.* Efflorescence resulting from the drying out of the bedding mortar may cause temporary disfigurement at the surface of the finish (see 5.1.1.1).

(4) *Integral water-repellents (waterproofers).* The use of integral admixtures containing water-repellent ingredients, such as metallic soaps in the base concrete, will make the hardened surface difficult to wet and will result in poor adhesion of conventional cement and sand bedding; a similar effect has been produced by some other admixtures. In these circumstances, and where firm adhesion between base and bedding is required, it will be necessary to provide a 'suction coat' i.e. a layer of cement and sand, without admixture, placed monolithically with the wet base after which, standard direct bedding methods may be employed.

3.1.3 Variations in moisture content and temperature in a floor. In solid and suspended floor constructions, the base and the finish usually have different dimensional reactions to changes in moisture content and temperature. Probably the most extreme relative moisture movements occur when new concrete floors are covered before most of the drying shrinkage of the concrete has taken place. Here the shrinkage of the base persists long after the finish has reached equilibrium with the result that compression forces developing in the finish may ultimately break down the adhesion between the finish and the bedding mortar and relieve themselves by springing the finish away from the bed. Vibration, impact and thermal shock can often produce early failure while the floor finish is in the stressed condition and even when such hazards have not resulted in failure, the further contraction of the base in very cold weather may be sufficient to do so.

3.1.4 Chemical attack. In connection with the use of a particular type of floor finish in a potentially-corrosive environment there are two aspects to consider; the resistance to chemical attack of the floor finish itself including upstands; and the resistance of the bedding and jointing material used. The chemical resistance of the more common jointing materials is shown in Table 1.

Having selected the appropriate floor finish, fixative and jointing compound there are a number of other factors to consider at the design stage:

(1) Adequate falls in the most corrosive situations. Guidance on this point is provided in the Building Research Establishment Digest No. 120*.

(2) The positioning of drainage channels, especially in relation to the wheels of traffic e.g. trolleys in the floor area.

(3) Prevention of leakage of corrosive liquids where the floor covering adjoins walls, fittings, etc.

(4) Allowance for wider jointings to be pointed with corrosion-resisting compounds.

* Building Research Establishment Digest No. 120, 'Corrosion resistant floors in industrial buildings'.