

BS 5385-2:2015



BSI Standards Publication

Wall and floor tiling –

Part 2: Design and installation of external ceramic, natural stone and mosaic wall tiling in normal conditions – Code of practice

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Contents

Foreword *ii*

1	Scope	1
2	Normative references	1
3	Terms and definitions	2
4	Exchange of information and time schedule	3
5	Materials	5
6	Design	8
7	Backgrounds	11
8	Preparation of backgrounds	15
9	Cement and sand rendering	19
10	Movement joints	23
11	Application of tiles – methods and materials	27
12	Bedding in adhesives	28
13	Tile joint treatment	29
14	Application of mosaics – methods and materials	31
15	Setting out	32
16	Preparation of mosaics	32
17	Adhesive bedding methods for mosaics	33
18	Application of mosaics	33
19	Grouting of mosaics	33
20	Glass mosaics	33
21	Cleaning and maintenance	34

Annexes

Annex A (informative) Ceramic tiles and mosaics	35
Annex B (informative) Natural stone descriptions	35

Bibliography 37

List of figures

Figure 1 – Illustration of selected definitions	2
Figure 2 – Typical movement joint details in external wall tiling	25
Figure 3 – Position of movement joints in concrete frame construction at abutment of brick/block infill	26

List of tables

Table 1 – Classification of ceramic tiles with respect to water absorption (E) and shaping	5
Table 2 – Backgrounds: direct fixing	13
Table 3 – Backgrounds: requiring rendering	14

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 38, an inside back cover and a back cover.

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 30 April 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This part of BS 5385 supersedes BS 5385-2:2006, which is withdrawn.

Relationship with other publications

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

- Part 1: *Design and installation of ceramic natural stone and mosaic wall tiling in normal internal 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 4: *Design and installation of ceramic and mosaic tiling in special conditions – Code of practice*
- Part 5: *Design and installation of terrazzo, natural stone, agglomerated stone tile and slab flooring – Code of practice*

Information about this document

This is a full revision of the standard, and introduces the following principal changes.

- includes recommendations on natural stone.
- expanded cement and sand mortar information.
- restrictions on mesh-backed mosaics above 3 m.
- includes repairs in existing buildings.

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 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.

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 following specific regulations:

- Building and Construction Regulations under the Factories Act [1]
- Lifting Operations and Lifting Equipment Regulations [2]
- Manual Handling Operations Regulations [3].

1 Scope

This part of BS 5385 gives recommendations for the design and installation of external ceramic, natural stone and mosaic wall tiles in normal climatic conditions in the UK. It deals with the types of backgrounds and their suitability to receive tiling using the following fixing methods:

- a) bedding in cementitious or reaction resin adhesives on an intermediate substrate or as a direct bedding method;
- b) bedding mosaics in cement and sand mortar on rendering or as a direct bedding method on appropriate backgrounds.

NOTE Cement and sand mortar is seldom used as the bed for external wall tiling but, if needed, see BS 5385-1.

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 410-1, *Test sieves – Technical requirements and testing – Part 1: Test sieves of metal wire cloth*

BS 1210, *Specification for wood screws*

BS 4483, *Steel fabric for the reinforcement of concrete – Specification*

BS 4551, *Mortar – Methods of test for mortar – Chemical analysis and physical testing*

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

BS 5974, *Code of practice for the planning, design, setting up and use of temporary suspended access equipment*

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

BS 6213, *Selection of construction sealants – Guide*

BS 8000-11, *Workmanship on building sites – Part 11: Internal and external wall and floor tiling – Ceramic and agglomerated stone tiles, natural stone and terrazzo tiles and slabs, and mosaics – Code of Practice*

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

BS EN 12004:2001, *Adhesives for ceramic tiles – Requirements, evaluation of conformity, classification and designation –*

BS EN 12057, *Natural stone products – Modular tiles – Requirements*

BS EN 12371, *Natural stone test methods – Determination of frost resistance*

BS EN 13139:2002, *Aggregates for mortar*

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

BS EN 13914-1:2005, *Design, preparation and application of external rendering and internal plastering – Part 1: External rendering*

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

BS EN 14647:2005, *Calcium aluminate cement – Composition, specifications and conformity criteria*

BS EN ISO 10545-12, *Ceramic tiles – Part 12: Determination of frost resistance*

3 Terms and definitions

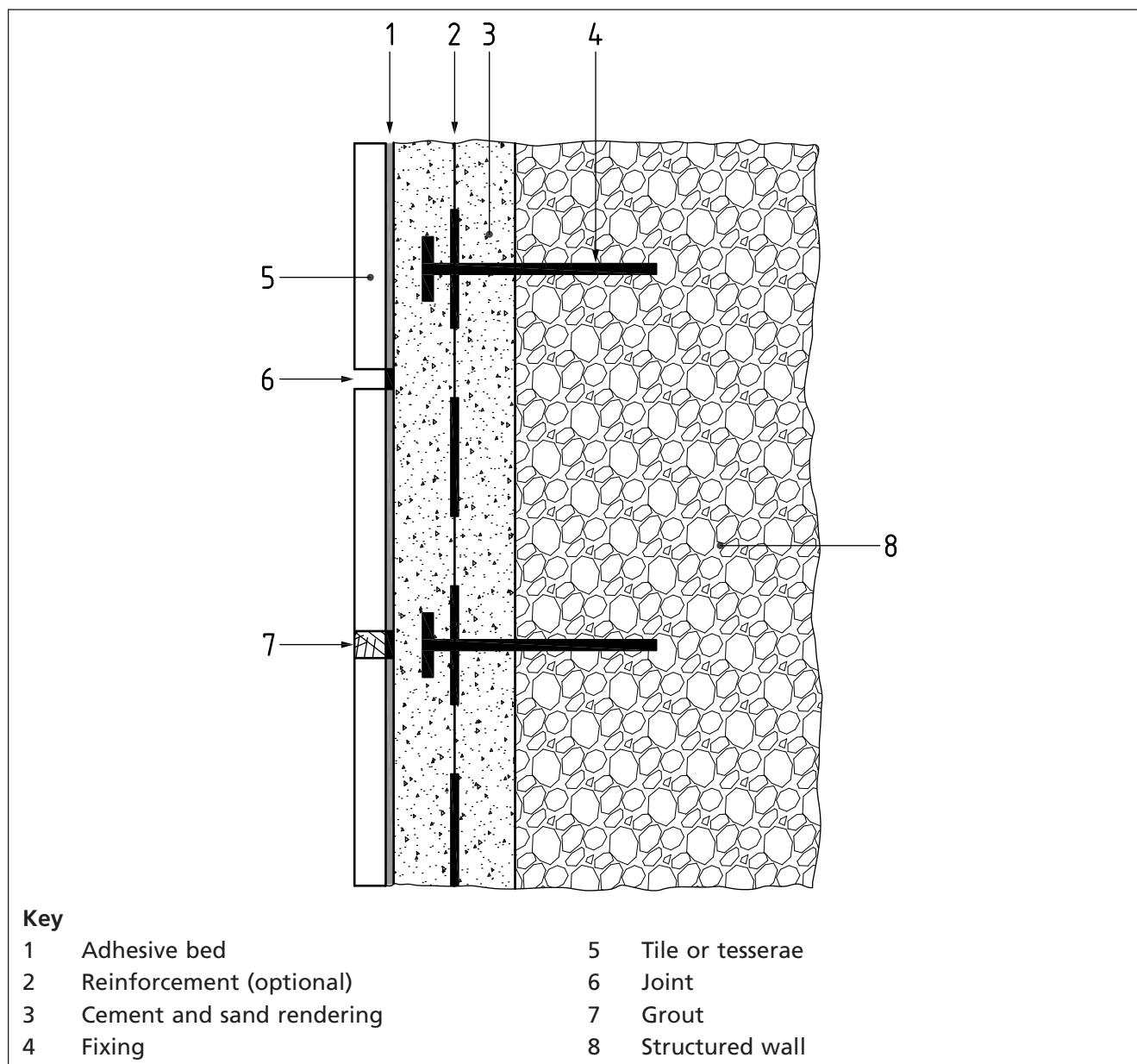
NOTE An illustration of some selected definitions is shown in Figure 1.

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

3.1 bond breaker tape

self-adhesive tape, used to prevent sealant sticking to a substrate

Figure 1 Illustration of selected definitions



4 Exchange of information and time schedule

NOTE Clause 4 deals with the exchange of information for the whole wall, including tiles, tile bed, background and intermediate substrate (if any).

4.1 Exchange of information

The 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 sought and documented:

- 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 might be subjected in service (e.g. mechanical cleaning);
- c) Wall(s). Type and age of construction, location, height, type and accuracy of backgrounds and need for intermediate substrate or special mechanical fixing systems (see 6.5);

NOTE Permissible deviations from horizontal and perpendicular lines in building construction are usually greater than appropriate for ceramic tiling or mosaic finishes.

- d) Associated work. Elements 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. 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 is liable to be a health risk;
- h) Time schedule. A time schedule for the progress of the work (see 4.3); and
- i) Testing. Details of any installation compliance testing required.

4.2 Provision of utilities, facilities and materials

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 is provided and by whom:

- a) adequate clean, dry, lockable storage space protected from frost (if necessary) (see 5.1);
- b) clean water supply adjacent to working areas;
- c) adequate artificial lighting (if necessary), e.g. for tiling within a protected enclosure;
- d) safe means of access and places of work, to include, where necessary, suitable scaffolding and staging, which should conform to BS 5974;

NOTE 1 Attention is drawn to the requirements of the Building and Construction Regulations under the Factories Act [1].

- e) unloading and hoisting facilities;

NOTE 2 The following references are valid: Lifting Operations and Lifting Equipment Regulations [2], Manual Handling Operations Regulations [3].

- f) electric power supply adjacent to working areas;
- g) protection of work during and after fixing (see 6.3);

- h) supplies of cement and sand in accordance with 9.2.1 and 9.2.2; and
- i) tiles, adhesives, grouts, primers and sealants.

A check should be made to ensure that all materials needed for the installation are available.

4.3 Time schedule

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

In preparing the time schedule, each operation should be considered in relation to others. Due consideration should be given to the most economical use of general plant and scaffolding by all trades, also to ensure that the various trades do not interfere unduly with each other's work.

For economic and efficient application of external tiling and mosaics, work should begin at the highest point of the construction. In addition, in certain forms of a multi-storey construction, some deflection of the wall can occur at lower levels as the construction increases in height and the loading consequently increases. It is important, therefore, that application of tile or mosaic tiling should not commence until the construction has been erected to its full height.

At least six weeks should be allowed in the time schedule for the drying out and initial shrinkage of the structural or non-structural concrete. If an intermediate substrate e.g. rendering is subsequently applied, each coat should be cured, allowed to dry and harden in accordance with BS EN 13914-1 to permit drying shrinkage before the final coat is applied. The final coat should be cured and left to dry for at least a further two weeks. The drying times of all in situ backgrounds are the minimum required under optimum conditions and these drying times should be considerably extended under adverse drying conditions on site, e.g. low temperatures and wet conditions.

The schedule should allow sufficient time for the cutting of holes and chases and/or other work involving the use of percussion tools in or on the walls to receive a bedded finish, and adjacent walls, to be completed before a substrate is applied. All the time allowances mentioned are equally applicable where a substrate is to be omitted and the tile or mosaic finish bedded directly to the structural background.

NOTE Cutting holes in natural stone might need to be carried out at the factory. If undertaken on site, use only equipment that will not result in damage to the stone. For some types of natural stone, e.g. granite such work can only be carried out with correct dust control.

The schedule should provide for the completion of all necessary subsidiary work before the fixing of tiles or mosaics begins. The schedule should include times for commencement and completion of tiling or mosaic work to the different parts of the construction, allowing sufficient time intervals between the operation of the bedding, grouting and final cleaning down.

Provision should be made for adjustment to allow for suspension of operations due to frost or other unfavourable weather or other conditions that jeopardize the safety of workers and/or 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. In addition, heating might be necessary.

5 Materials

5.1 Transport and storage

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

Materials should be stored in clean, dry, frost-free (if necessary), lockable storage to avoid excessive handling, theft or damage.

5.2 Ceramic tiles

Ceramic tiles for external use up to 3 m should have water absorption of not more than 3% and should either be extruded tiles type AI_a or AI_b or dust-pressed tiles types BI_a and BI_b (see Table 1 and 6.3).

Ceramic tiles for external use above 3 m should be Class AI_a or BI_a and the tile surface should not be larger in facial surface area than 0.1 m² unless secured by mechanical means (see 6.5).

Before selecting a particular type of tile, advice about its suitability should be obtained from the supplier.

Table 1 Classification of ceramic tiles with respect to water absorption (E) and shaping

Shaping (see Note)	A Extruded	B Dry pressed
Group I	Group AI _a	Group BI _a
E ≤ 3%	E ≤ 0.5%	E ≤ 0.5%
	Group AI _b	Group BI _b
	0.5% < E ≤ 3%	0.5% < E ≤ 3%

NOTE See BS EN 14411:2012, Table 1 for water absorption limits for Groups II and III tiles which are of higher water absorption and therefore unsuitable for external use.

5.3 Mosaics

NOTE Annex A contains information about mosaics.

Mosaics with any form of mesh backing should not be used.

Ceramic tesserae should conform to the relevant physical and chemical properties given in BS EN 14411.

For mosaics that are to be fixed in locations liable to frost, ceramic tesserae should pass the frost resistance test as described in BS EN ISO 10545-12.

Before selecting a particular type of mosaic, advice about its suitability should be obtained from the supplier.

5.4 Natural stone

Stone should conform to BS EN 12057 and declared to be appropriate for external use.

NOTE 1 Descriptions of natural stone can be found in Annex B.

NOTE 2 Natural stone tiles as described in BS EN 12057 can be calibrated or not calibrated. Natural stone tiles are flat pieces of natural stone square or rectangular in standard sizes, obtained by cutting or splitting at a nominal thickness of ≤ 12 mm. There are no limitations on the length or width.

The stone used to produce the tiles for external use should be tested to the freeze thaw test in BS EN 12371. Stone tiles which are resin mesh backed should not be used.

Natural stone for external use at above 3 m should not be larger in facial surface area than 0.1 m² unless secured by mechanical means (see 6.5).

5.5 Adhesives

5.5.1 General

Cementitious adhesives (C) and reaction resin adhesives (R) should conform to BS EN 12004.

Adhesives conforming with BS EN 12004 are designed for use with ceramic tiles. The performance characteristics set out in this standard do not apply to all types of natural stone. For external conditions, the adhesive used should achieve the required performance according to BS EN 12004.

5.5.2 Admixtures to adhesives

An aqueous polymer dispersion can be incorporated in cement based adhesives to obtain greater adhesion, improved resilience or some reduction in water permeability. Such admixtures should be used only with adhesives approved by the manufacturer. The use of admixtures is not necessary when adhesives with additional characteristics such as those given in BS EN 12004:2001, under Type C Class are used.

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

5.6 Bonding agents

NOTE Bonding agents are available to improve the adhesion of renderings and/or tile beds to backgrounds.

Bonding agents are usually mixed with cement and sand, or more commonly with neat cement, and should be applied as a wet slurry or stipple immediately prior to the application of the mortar. For optimum results the bonding agent should also be used as an admixture in the mortar. This gives improved compressive and tensile strength, allowing mortars to be applied in thinner sections, thus reducing the weight of the construction.

Bonding agents based on polyvinyl acetate or any other polymer affected by moisture should not be used in external applications.

The manufacturer's recommendations for the particular type of bonding agent to be used and its method of application should always be strictly followed.

5.7 Sealants and back-up materials for movement joints

5.7.1 General

Materials for movement joints should be non-rigid; they should combine the properties of resilience and/or plasticity within the maximum temperature ranges likely to be encountered and should be resistant to mould growth.

5.7.2 Sealants

Joint sealants should be selected and applied in accordance with the guidance given in BS 6213.

Sealant manufacturers' advice should be taken into account as the properties of individual sealants can vary. Generally, a sealant should be capable of accommodating the anticipated amount of movement without loss of adhesion to the sides of the joints and be able to withstand the normal service conditions affecting the installation, e.g. resistant to water, ultraviolet light.

Where movement is large and frequent, Class 25 sealants should be used. For joints undergoing smaller and less frequent, movement Class 20 or Class 12.5 can be considered however where the class number is less than 20 the sealant might not be suitable over structural movement joints. For a given extent of movement, the narrower the joint, the higher the sealant class needed to accommodate the movement.

NOTE Information on sealant installation is given in 10.4.

5.7.3 Back-up materials

The compressible back-up material should be a material to which the sealant does not adhere, or one which can be covered with a bond breaker tape to prevent adhesion.

The back-up material in the lower part of the joint should be compatible with the sealant used, should recover after compression and should support the sealant. It should not exude bituminous or oily products and should not absorb excessive amounts of moisture. In particular, its compressibility should be such that when the joint closes the sealant is not forced out. Suitable materials include closed cell cellular rubber and plastics, such as cellular polyethylene, some fibre building boards, cork boards and mineral or synthetic ceramic cords or blankets. Back-up materials are available in sheet strip and cord form in a range of sizes.

NOTE Information on back-up material installation is given in 10.5.

5.8 Grouts

5.8.1 General

Grouts should have good working characteristics, low shrinkage and good adhesion to the sides of the tiles, whilst being capable of being cleaned off the face of the tiles without undue difficulty. When selecting a grout the specifier should establish that it is suitable for exposure to external conditions.

5.8.2 Types of grout

5.8.2.1 Proprietary grouts

Proprietary grouts should conform to BS EN 13888:2009, Type CG or RG and should be one of the following types:

- a) mixes based on cement and mineral fillers but modified by the inclusion of various additives, including pigments and organic additives, that only require to be mixed with clean water to the recommended consistency (CG);
- b) mixes based on cement and mineral fillers and additives to be mixed with aqueous synthetic polymer dispersions to the recommended consistency (CG); or
- c) mixes based on epoxide resin consisting of separate pre-gauged components to be mixed together immediately before use (RG)

NOTE 1 Some types of grout might cause "picture frame" staining of natural stone.

NOTE 2 Epoxide resin grouts might take longer to apply and clean off than cement based grouts.

NOTE 3 Epoxide grout might not be suitable for use with natural stone.

5.8.2.2 Cement and sand mortar grouts

Cement and sand mortar grouts are sometimes used for grouting joints over 3 mm in width. In order to promote good adhesion and strength development there should be dampness in the joint cavities.

Mixes of this type are more suited for mosaics in cement and sand mortar beds that are thick enough to retain sufficient dampness when re-wetted.

NOTE The physical properties of cement and sand mortar grouts are generally inferior to those of proprietary grouts, which provide performance and properties that are more consistent.

Neat cement mixed with water should not be used as a grout for external tiling except for pre-grouting paper-faced mosaics with narrow joints.

5.8.3 Admixtures to grouts

NOTE Admixtures, normally in the form of aqueous dispersions, can be incorporated in grout mortars based on cement and sand to enhance adhesion in the tile joints, whilst improving the resilience and reducing the water permeability of the hardened grout mortar. Proprietary aqueous admixtures are available for incorporation in proprietary grouts to provide improved characteristics.

Admixtures should be used strictly in accordance with the manufacturer's instructions and they should not be added to a proprietary grout unless approved by the grout manufacturer.

5.9 Reinforcement and metal lath for cement and sand rendering

Metal reinforcement should be of austenitic stainless steel wire conforming to BS 4483. The wire should be 2.5 mm diameter welded into a mesh size of approximately 50 mm × 50 mm. Fixings should be of austenitic stainless steel. The type of fixing depends upon the background.

Galvanized reinforcement as recommended in BS 5385-1 should not be used in external rendering, except where it might be suitable for small areas in sheltered locations.

6 Design

6.1 Initial considerations

In the early stages of designing external wall tiling, consideration should be given to the following:

- a) type, size and colour of tile;
- b) type and width of the joints;
- c) type, height and age of backgrounds (see Clause 7);
- d) method and materials to be used for bedding or mechanically fixing the tiles (see Clause 6.5, Clause 12 and Clause 17); and
- e) position and requirements for movement joints (see Clause 10).

6.2 Appearance and effect

NOTE Many types of tiles and mosaics are available but, as with most other building materials, some variations in colour and size might occur. In selecting tiling for architectural effect, some limitation to choice might be imposed by the technical ability of the tile or mosaic to fulfil the durability requirements for any specific application.

The designer should consider the merits of the various finishes available in tiles and select finishes that give the best balance of attributes. For example, a tile with a highly glazed finish reflects light differently from an unglazed tile and is more self-cleaning.