

**BS 5385 : Part 2 : 1978**

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Code of practice for



Wall and floor tiling



Part 2. Code of practice for external ceramic wall tiling and mosaics

(formerly CP 212 : Part 2)



Carrelages et dallages

Partie 2. Code de bonne pratique relatif aux carreaux et mosaïques céramiques pour revêtement des murs extérieurs



Wand- und Bodenfliesen

Teil 2. Leitfaden für keramische Fliesen und Mosaik für Außenwände

BS 5385 : Part 2 : 1978

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This code of practice represents a standard of good practice and therefore takes the form of recommendations. Compliance with it does not confer immunity from relevant statutory and legal requirements.

Foreword

This Part of the code of practice BS 5385 has been prepared by a reconstituted Code Drafting Committee and takes account of methods and materials developed since the 1966 edition was published. It also offers more precise and detailed recommendations on backgrounds and their treatment, the application of tile and mosaic cladding and the design and filling of joints. It describes a method of applying rendering through reinforcement anchored to the structure, now recognized as an advisable precaution against failure in the event of the rendering failing to adhere permanently to its background.

Throughout the code, references to cladding are intended to apply equally to tiling and mosaics, except for certain provisions in section five where attention is drawn to some procedures for mosaic that differ from those for tiling.

An updated Part 1 was published in 1976* to cover internal ceramic wall tiling and mosaics to be installed in normal conditions, which imply an environment produced as the result of normal conditions of temperature and humidity. It is not to be inferred from this that all recommendations made in Part 1 of the code are unsuitable for more extreme conditions.

This standard will be issued in five Parts, the other Parts are as follows:

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

Part 3.† Code of practice for laying ceramic floor tiles and mosaics.

Part 4. Code of practice for ceramic tiling and mosaics in specific conditions.

Part 5.† Code or practice for laying terrazzo tile and slab, stone and composition block floors.

Insert the following associated footnote:

*† In preparation.

British Standard Code of practice for

Wall and floor tiling

Part 2. Code of practice for external ceramic wall tiling and mosaics

Section one. General

1. Scope

This Part of the code concerns external ceramic wall tiling and mosaic in normal conditions. It deals with the types and classes of backgrounds and their suitability to receive a bedded finish using the following fixing methods, which also are described in the relevant sections:

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

NOTE. The word 'weight' has been used in its colloquial sense in this standard, instead of the formally correct word 'mass'.

2. References

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

3. Definitions

For the purposes of this code the following definitions apply. All other terms used throughout the code have a commonly accepted usage in the building industry and should be readily understood without definition.

3.1 adhesive. Bedding material other than cement/sand bedding mortar.

3.2 backgrounds. This term is used in three senses:

- (a) those which, without treatment, are suitable to receive the bedded finish by a direct bedding method;
- (b) those already treated to receive the bedded finish;
- (c) those requiring some form of surface treatment in readiness for the bedded finish.

3.3 bedded finish. The tile or mosaic finish including its bedding.

3.4 bedding. A layer of specified material that bonds the tiles or mosaics to a background.

3.5 creep. A slow inelastic deformation or movement of material under stress.

3.6 direct bedding/direct fixing. The application of a bedded finish to a background without an intermediate substrate.

3.7 grouting/grout. The operation of, or the materials used in, filling the joint cavities between tiles or mosaics.

3.8 intermediate substrate. A layer, e.g. rendering, applied to a background to provide a surface suitable to receive the bedded finish.

3.9 joint. A space between the edges of adjacent tiles or mosaics.

3.10 movement joint. A joint, usually wider than a normal joint between tiles or mosaics, designed to accommodate movement in the installation.

3.11 pre-grouting. The operation of, and the materials used in, filling the joint cavities between mosaics on the reverse sides of the sheets before the sheets are placed in position.

3.12 thick bed. Bedding exceeding 3 mm in thickness.

3.13 thin bed. Bedding not exceeding 3 mm in thickness.

4. Exchange of information and time schedules

4.1 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. If bills of quantities form part of the contract, they should be prepared in accordance with the 'Standard method of measurement of building works' or the 'Code for the measurement of building works in small dwellings', as appropriate*. As soon as possible after acceptance of contract, there should be an exchange of information between those responsible for the execution of the backgrounds, the application of tiling and mosaics systems, and other trades whose work will affect or be affected by the tiling or mosaics. Any special conditions to which the installation may be subjected in service, e.g. drastic cleansing operations, should be made known and allowed for in the specification or discussed prior to the preparation of estimates.

4.2 Unless the terms of the subcontract state otherwise and are known to the tiling contractor at the time of quotation, the main contractor should be responsible for the provision of the following at such times and in such a manner as to avoid the tiling contractor incurring lost time in the proper execution of his work:

- (a) adequate clean, dry, frostfree storage (lock up);
- (b) water supply adjacent to working areas;
- (c) adequate artificial lighting if required;
- (d) suitable scaffolding and staging, which should be in accordance with the requirements of the Building and Construction Regulations made under the Factories Act;
- (e) unloading and hoisting facilities;
- (f) electric power supply adjacent to working areas;
- (g) protection of work during and after fixing.

*Both publications may be obtained from the Royal Institution of Chartered Surveyors, 12 Great George Street, London SW1P 3AD.

4.3 For economic and efficient application of external tiling or mosaics, the work should begin at the highest point of each building. In preparing a time schedule for the work involved in a building each operation should be considered in relation to the others, due consideration being given to the most economical use of general plant and scaffolding by all trades, also to ensuring that they do not interfere unduly with each other's work. The whole of the work should be carried out in accordance with the requirements of the Building and Construction Regulations made under the Factories Act.

4.4 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.

4.5 At least 4 weeks should be allowed in the time schedule for the drying out and initial shrinkage of the structural or non-structural fabric before the application of an intermediate substrate, e.g. rendering. The schedule should allow also for all 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 relevant where a substrate is to be omitted and the tile or mosaic finish bedded directly to the structural background.

4.6 The time schedule should also provide 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 operation of the bedding, grouting and final cleaning down.

4.7 The time schedule should include a provision for adjustment to allow for suspension of operations due to 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.

Section two. Materials and storage

5. Tiles and mosaic cladding

5.1 The cladding referred to in this code consists of glazed and unglazed ceramic tiles other than those requiring cramping or other mechanical fixing, and of mosaics of various types: their compatibility with the materials or methods recommended for fixing and their suitability for application to the various backgrounds and in environments described in this code will depend on such factors as their composition, weight and accuracy of shape. Glazed tile cladding includes tiles impregnated with resinous materials; these tiles, which are intended for use at low levels, are compatible with only a limited range of bedding materials.

There is at present no British Standard by which to define tiles suitable for use in external situations and the specifier should satisfy himself that those he selects have the properties necessary to withstand the conditions to which they may be exposed. It should be appreciated that many tiles produced are not intended for external situations.

There are several different types of mosaics available in a variety of shapes and sizes, including glazed and unglazed

ceramic mosaics, glass mosaics, and marble mosaics. To facilitate ease of handling, mosaics are assembled as sheets, the separate pieces of mosaics being glued either face side down to paper (paper-faced mosaics), or bedding side down to nylon adhesive strips or nylon fabric net (nylon-backed mosaics) or other suitable material.

When sheets are backed with nylon strip, nylon fabric net or similar materials, the backing will be embedded in the bedding medium, i.e. mortar or adhesive. These forms of sheeted mosaic may be precluded from use externally if the sheet backing adversely affects the development of adequate and permanent adhesion between the mosaic and the bedding medium; this situation can arise when

- (a) the exposed areas of individual mosaics are not sufficient to permit the bedding making contact over an adequate proportion of the area of each mosaic;
- (b) the strips or net or the glue used to bond them are of types that will deteriorate in service or are not compatible with the bedding medium;
- (c) the glue is spread on to the backs of individual mosaics instead of being confined to the strips or net.

As there is at present no British Standard for mosaics, it is recommended that before selecting a particular system the advice of the mosaics suppliers or mosaic fixing specialists should be obtained as to the appropriate fixing method and the suitability of a particular type of mosaic for a particular environment.

Clean, dry, frostfree storage should be provided on site and adequate precautions taken to avoid excessive handling and possibility of damage.

6. Cements

The cements referred to in this code should be used in accordance with the manufacturer's instructions and should comply with the requirements of the relevant standards where applicable as follows:

Portland cement (ordinary and rapid-hardening)	BS 12
Portland-blastfurnace cement	BS 146
Masonry cement	BS 5224
Sulphate-resisting Portland cement	BS 4027

The recommendations in this code refer to cement complying with the requirements of BS 12, unless otherwise stated.

Cements packed in the customary multiwall paper sacks remain usable for considerable periods if supported out of contact with the floor in a dry cool store. If large quantities are involved, deliveries should be kept separate and used in succession. In rare instances a delivery may be still warm from the manufacturing process, and such material should preferably be allowed to cool before use.

Cement showing signs of deterioration, e.g. hard lumps, should be rejected.

7. Sand

7.1 General. The nature of the sand used has a great effect on the properties of mortars in the fresh and hardened states.

If mortars are to be satisfactory for rendering and tile fixing, they have to be workable and should retain water against any tendency to absorption by surfaces to which they may be applied. On the other hand the long-term suitability of a mortar depends largely on its drying shrinkage, and this is to a great extent governed by the type and source of the sand and by the amount of water that has to be added in order to confer the required properties on the fresh mix.

Evenly graded sands tend to yield mixes that, if proportioned appropriately (see clause 19 and 22.1.3), possess the ideal properties.

Sands containing an abnormal proportion of fine grains may cause the mix to require an excessive addition of water. Sands containing an undue amount of absorbent matter, such as chalk, clay or loam, may have a similar effect.

All sand should be protected from the weather so that its moisture content does not fluctuate widely through repeated wetting and drying. Sand 'bulks' according to its moisture content, so that changes in the latter can affect the consistency of volume batching and hence the mix proportions, water content and consequent drying shrinkage.

Sand that is at a temperature at or below the freezing point of water may impair the setting of the cement in the mix, particularly if its use leads to the applied material freezing before it hardens. In winter, therefore, precautions should be taken to exclude such sand from use.

Apart from considerations of grading, sands should be inert and not contain significant quantities of foreign matter able to affect materially the adhesion of renderings, beddings, or tiles.

7.2 For cement/sand renderings. In the absence of experience concerning the suitability of a given sand, sands should comply with the requirements of BS 882 or BS 1199, although those having gradings falling within zone 1 (table 2) of BS 882 : Part 1 : 1965 or Part 2 : 1973 are likely to have poor water retention and to be too harsh for normal use. Those having gradings within zone 2 and 3 are more likely to yield mixes having acceptable consistencies and drying shrinkages.

7.3 For cement/sand tile-fixing mortars. Sands falling within the classification given in BS 1199 contain greater proportions of finer particles than the BS 882 sands referred to in 7.2, and thus tend to be better suited to the relatively thin layers of mortar applied when fixing tiles and mosaic, although sands complying with the requirements of BS 882 (zones 2 and 3) are suitable in bedding mixes for deep keyed or frogged tiles.

8. Cement-based adhesives

These are usually proprietary compositions specifically manufactured for tile fixing. They are usually in dry powder form containing cement as the basic ingredient, and generally require mixing on site with water only. Pending the issue of a British Standard, they should comply with the basic requirements given in appendix A to Part 1 : 1976 of this code.

9. Organic-based adhesives

These are usually proprietary organic adhesives of diverse composition, specifically manufactured for tile fixing. Pending the issue of a British Standard, they should comply with the basic requirements given in appendix A to Part 1 : 1976 of this code.

10. Water

Water should be fresh and clean. All containers for storing or carrying water or for soaking tiles should be clean. Sea water is not suitable. Attention is drawn to BS 3148.

11. Rules (battens)

Rules should be true, and equal to the combined thickness of the tile and fixing bed. They should be cleaned after use.

12. Materials suitable for movement joints

Pending the issue of British Standards, materials for movement joints should be composed of non-rigid materials applied either in the form of a compound or a preformed strip; they should combine the properties of resilience and/or plasticity within the maximum temperature ranges likely to be encountered. Table 1 provides a guide to most of the sealants in current use and includes a summary of their properties.

13. Grouting materials

See 23.2, 23.3 and 23.4.

14. Bonding agents

Bonding agents are materials introduced during the last 20 years to improve the adhesion of mortar to its background.

If selecting a bonding agent, the specifier should ensure that the manufacturer is given full particulars of the installation (including the type of background, tiling system, and conditions of service) and that the manufacturer's recommended grade and method of application are strictly adhered to.

Various proprietary materials are available as follows.

(a) *Organic polymer-based materials.* These include materials based on styrene-butadiene, polyvinyl acetate, or acrylic resins. These materials differ in their properties, particularly in respect of resistance to moisture, and it is essential that the correct material for the application is selected, and that it is used in accordance with the manufacturer's recommendation (see 18.2.1). They are usually mixed with cement and sand or cement only and applied as a wet wash or stipple immediately prior to the application of the mortar. Application of the bonding agent as a neat film is not generally recommended and should not be attempted with materials such as polyvinyl acetate, or acrylic resins that are affected by moisture.

(b) *Cement-based materials.* These are proprietary materials having properties similar to the traditional spatterdash of rich cement mortar and have been used successfully as a wet wash or stipple immediately prior to the application of the mortar.

As a result of continuing research, types additional to those given in (a) and (b) may be developed for successful application.

Gypsum plaster should not be used in any circumstances.

15. Metal reinforcement

Metal reinforcement should be galvanized, preferably after manufacture and as specified in BS 729, or should be of austenitic stainless steel. Fixings should be of austenitic stainless steel. Welded wire mesh should be 50 mm x 50 mm mesh and have wires not less than 2.5 mm in diameter.

Expanded metal lathing is not a suitable form of reinforcement for use in rendering as recommended in this code (see 19.2) but new forms of this and other metal mesh are in the course of development.

Section three. Design considerations

16. General

The functions of external wall tile and mosaic cladding are to obtain an overall architectural expression or to achieve a particular decorative effect, to cover an unsightly surface, to increase durability and reduce maintenance of a structure and to assist in protecting the structure against climatic and other environmental conditions.

The success of a cladding installation in fulfilling these functions requires that consideration is given to the following factors early in the design stage as they affect the design of the structural and architectural details, the choice of cladding and decisions on bedding and jointing methods:

- (a) appearance or effect desired, see 16.1;
- (b) exposure conditions and protection, see 16.2;
- (c) nature of the background, see 16.3;
- (d) suitability of the tiles or mosaic, see 16.4.

16.1 Appearance and effect. Many types of tiles and mosaic are available to enable selection to be made for colour, scale, texture, pattern, etc. to satisfy the requirements of most architectural concepts. In selecting cladding for architectural effect it is necessary to accept that some limitations may be imposed as the result of the manufacturing processes required to impart the necessary durability factors to the products; these processes may, for example, restrict the colour range or the overall size or thickness of a product.

The effect created by the joints in tiling should be considered. The grid pattern of joints is an integral feature and no attempt should be made to render them less conspicuous by reducing their widths below those recommended in 16.2.3. It is not advisable to try to obscure the joints by tinting them to match the colour of the tiles as this serves only to emphasise any slight differences in plane between adjacent tiles. It is better that the colour of the joints contrasts with the colour of the tiles and, usually, the neutral colour of cement joint filling is satisfactory; this material can be tinted if desired to achieve a particular effect, but it has to be recognized that the tinting will become obscured in time by the deposition of dirt from the atmosphere. When the joint lines are strongly defined, it may be thought important that the grid should be intact, i.e. not interrupted by part tiles, and the designer should then ensure that the sizes of walls, openings and margins are planned to accommodate whole tiles; only limited adjustments to the spacing of tiles are possible during fixing as it is generally expected that joint widths should be as uniform as possible throughout an installation. Similar considerations apply to mosaic work, although the smaller units of mosaic sometimes allow suitable adjustments to be made in the preparatory work.

As with most other building materials, some slight variations in shade can occur.

16.2 Exposure conditions and protection. Exposure to thermal effects, water penetration, pollution and frost should be anticipated and considered in relation to the choice of cladding and bedding, the design of joints and the detailing of architectural features. Relevant considerations are indicated in 16.2.1, 16.2.2, 16.2.3 and 16.4; bedding materials and methods are described in section four.

16.2.1 Thermal effects. Solar heat is not fully absorbed by the cladding, some of it being reradiated, and some reflected and removed from the cladding by circulating air currents. Reflection is influenced by the colour of the cladding. Light-coloured cladding reflects and radiates heat; dark-

coloured cladding mainly reradiates heat only and therefore absorbs and conducts to the backing a high proportion of solar heat gain. The temperature of the cladding will be affected by the thermal properties of the background.

Where it is suspected that thermal movement of the cladding may be excessive, special precautions such as flexible bedding or provision of movement joints should be considered.

16.2.2 Weathering. The surface of tiles and mosaics suitable for use in external situations will not suffer any physical damage from the accumulation of dirt and other matter deposited from polluted atmospheres. Irregular or streaky discoloration may occur where water run-off is concentrated. However, dirt does not readily collect and is easily removed from glazed surfaces. Certain chemicals in the atmosphere may cause an iridescent effect to appear on the surface of some dark glazed tiles and mosaics.

16.2.3 The design of joints. Tiles suitable for exterior use, being of several forms of manufacture, have different characteristics, some having considerable variations in size and shape. Glazed tiles are impermeable at their surface, and vitrified tiles, even when not glazed, have a negligible rate of transfer of water and water vapour. Consequently, the size and nature of the joints has to allow for variation in tile size, protection from outside water penetration, and passage of any water vapour from the wall to the outer atmosphere.

Joints between extruded tiles are usually approximately 10 mm wide to allow for the variations in size and tolerance, whilst joints between dust-pressed tiles may be considerably less. Where it is necessary to provide for adequate release of water vapour to the atmosphere, such as where there is no impervious layer or ventilation cavity in the wall, the area of jointing should be about 10 % of the total tile area. The relationship between joint width and tile thickness is also important; an adequate width of joint is necessary to enable the operative to insert the joint-filling material thoroughly, that is, solidly to the full depth of the joint spaces to eliminate the danger of voids.

Joint-filling materials, therefore, should be suitable for joints from 3 mm to 12 mm wide, capable of restricting undue water penetration but allowing passage of water vapour in appropriate conditions.

16.2.4 Architectural features. These should be designed to protect the cladding at positions where it may be vulnerable to water penetration or discoloration from the deposition of waterborne dirt; flashings and edge trims covering the top edges of cladding should be designed to prevent driven rain seeping into the structure over the top edge of the cladding; gutters and waterheads should be of adequate capacity and kept free from obstruction so that excess water is not allowed to overflow, causing dirty streaks and discolouration on the face of adjacent cladding. Other protective measures are as follows.

16.2.4.1 Parapet walls. The walls and top edge of cladding should be suitably capped. Water also has to be prevented from penetrating through to the cladding from behind; suitable protection should be applied to the backs of the walls and, in the case of cavity walls and walls of permeable construction, where height allows, provision made for ventilation under the capping and drainage at the base. Information on the construction of parapet walls is given in CP 121 : Part 1.

16.2.4.2 Sills. Preformed units designed to provide weather-tight protection to the structure should be specified for sills

at high levels and in other exposed situations; these should be suitably bedded to form an adequate seal over the top of the cladding below. Where there is less risk of water penetration, sills may be tiled, preferably with tiles having stoolings and robust nosings; the tiles should be laid to provide a sloping impervious surface with nosings overhanging the cladding below, and with all joints properly filled.

The practice of continuing mosaic cladding over sill ledges is not recommended.

16.2.4.3 External corners. In conditions that may introduce a substantial risk of damage, for example from mobile plant, suitable robust corner pieces should protect the cladding or be substituted for it.

16.2.4.4 Treatment at base. A space should be left between the bottom edge of cladding and paving to avoid possible disruption by any movement in the latter. At this position, and elsewhere where the cladding is interrupted horizontally, a drip should be formed by allowing the lowest row of tiles or mosaics to project down slightly beyond the bedding.

Cladding should not be carried across the exposed edges of horizontal damp-proof courses without break, since it may transmit moisture past the damp-proof course and make the latter ineffective; also, movement of the building on the damp-proof course may cause damage to the cladding. The top edge of cladding immediately beneath a damp-proof course should be protected by the latter, which should be designed to project through the cladding to serve as a flashing.

16.2.4.5 Horizontal surfaces. Horizontal surfaces should be sloped to inhibit the retention of water, especially where this is likely to contain destructive substances such as oxides of sulphur, the corrosive effect of which can be minimized if the rainwater carrying them is allowed to flow freely over the surface.

16.3 Nature of the background. Properties of background materials that determine their suitability include integral strength, contamination, trueness of construction, physical key, porosity, suction, moisture movement, thermal movement, drying shrinkage and creep.

Preparatory treatments are detailed in clause 18; in table 2 they are summarized and related to the background materials and properties for which they are recommended.

16.4 Suitability of the tiles or mosaics. Guidance on the selection of suitable materials is given in clause 5 in conjunction with 16.2.

The effects of solar heat when dark-coloured cladding is used are referred to in 16.2.1.

Tiles and mosaics as defined in clause 5 are non-combustible and when used as cladding can contribute to the fire resistance of a wall.

17. Backgrounds

17.1 General. It is essential that backgrounds be of sufficient strength to carry the weight of any intermediate substrate and the cladding and its bedding.

17.2 Soluble salts in backgrounds. Where backgrounds are damp and remain so for prolonged periods, soluble salts in them will migrate to the interface between background and rendering. Continued deposition in this way may eventually result in adhesion failure at the interface.

This risk is greatest where substantial amounts of soluble

sulphates are likely to be present as, for example, with some types of clay bricks and blocks. These sulphates may react with cement in the mortar of the joints or the rendering to form the mineral 'ettringite'. The formation of this mineral is accompanied by expansion, which may cause cracking and/or failure of adhesion.

If the installation is one where damp conditions are likely to persist, the use of constructional materials known to contain substantial amounts of soluble sulphates should be avoided. Where the use of such materials cannot be avoided, and in cases where the sulphate contents of the materials of construction are not known, it is recommended that sulphate-resisting Portland cement be used in both the mortar joints and subsequent rendering, and that the following precautions be adopted.

- (a) Exclusion of moisture from the construction by careful attention to flashings, roof drainage and movement joints. This is essential.
- (b) Provision of continual protection during the construction work.
- (c) Provision of adequate drying-out times at each stage in order to minimize the risk of damage.
- (d) Consideration of the use of the system of rendering through anchored reinforcement as described in 19.2.

18. Treatment of backgrounds

18.1 General. The suitability of a background to receive cladding will depend on the quality of its surface relative to the various methods and materials that can be used in applying the cladding. It may be necessary to introduce some intermediate treatment of which the following are examples:

- (a) keying of the surface;
- (b) application of a bonding agent to improve the adhesion potential;
- (c) providing an intermediate substrate to provide the necessary measure of suction and/or accuracy.

All backgrounds should be inspected for contamination and any potentially deleterious material removed.

Backgrounds not built accurately to a specified plane, or having surfaces that are uneven, may have deviations from a true flat surface too great to be capable of accommodation within the recommended thickness of a bedding material for cladding. If such backgrounds are bricks, blocks or concrete, it is recommended that an intermediate substrate should be applied to provide a true surface. When backgrounds are sheets, boards, metal, tiles or glazed bricks, the cladding usually will be bedded directly to them by means of a suitable thin-bed adhesive.

The reliability of a system employing bedding of thicknesses greater than those recommended in section four, e.g. to accommodate inaccuracies in a background surface, is doubtful, especially if the bedding thickness is not consistent throughout the installation, giving rise to variable stresses and the resultant possibility of failures such as adhesion loss or cracking.

Separately from the need to correct irregularities, rendering may still be advisable. The benefits to be derived from the use of thin-bed adhesives as bedding for cladding are realized only when the adhesives can be spread to a recommended and consistent thickness; thus the accurate surface that can be provided by a rendering coat makes an important contribution to the cladding system as a whole.

18.2 Treatment of backgrounds to receive cement/sand rendering

18.2.1 General. It is important to ensure that before applying rendering the background has dried out, especially where the background consists of materials such as lightweight concrete, calcium silicate-bricks, concrete bricks and concrete blocks, which can have an appreciable drying shrinkage related to their composition and degree of saturation: see also table 2.

Any laitance on the surface, and any areas contaminated by oil, grease or other substances that destroy the natural key for rendering, should be cleaned or removed.

It is essential that the surface to be rendered should provide a good key, a good bond being dependent upon a mechanical key and/or suction. Hacking may be necessary, but is not effective unless the surface is removed to a depth of about 3 mm. This may be done by hand or mechanically, for example by bush hammering, shot blasting, high-velocity water jets, etc., as appropriate. Alternatively, keying may be produced by the application of a 'spatterdash' coating; this may be a mix of cement and sand, or a proprietary composition, sprayed over the surface in the form of closely spaced globules.

Retarders painted on the shuttering enables a good key to be formed on the surface of concrete. Considerable care is required to ensure that all traces of retarder, unset cement and loose particles are removed and that the aggregate is exposed uniformly; this can be done by wire-brushing and thorough washing, using clean water with which a suitable detergent has been incorporated, followed by a final washing down with clean water. Retarders and detergents containing coloured dyes are recommended so that their removal can be seen to be complete when no traces of the dyes remain.

Indented keys in concrete may be provided by using rubber or composition formers fixed to the shuttering.

Several different chemical types of bonding agent are available. Before deciding on a proprietary bonding treatment, the advice of the manufacturer of any particular bonding medium should be obtained as to its suitability, its method of application and the physical and mechanical properties necessary in the surface to receive it. The agent employed should have properties after application that are not impaired by moist conditions. These bonding agents are usually employed in one of four ways:

- (a) as a coating preceding the application of a cement/sand rendering;
- (b) with an admixture, for example cement, and applied as a slurry bonding coat preceding the application of a cement/sand rendering;
- (c) as an admixture to the rendering mix, partially or completely replacing the gauging water;
- (d) by combining (a) or (b) with (c) in one rendering operation.

Porosity and suction affect the key and adhesion of cement/sand rendering. The amount of wetting, if required to reduce suction and to ensure uniformity of suction, will depend upon the nature of the background, the type of mix being used, the method of application and the weather conditions; wetting should be carefully controlled and only the minimum amount of water applied.

18.2.2 Clay brickwork, clay blocks, calcium silicate bricks, concrete bricks and blocks. Where the joints have not been raked back during construction, this should be done to a

depth of 13 mm. If the mortar is too hard for raking back or the bricks or blocks are very hard and smooth, other keying methods should be used; see **18.2.1**. Walls constructed of keyed bricks or blocks need no raking back.

18.2.3 In-situ and precast concrete. Grease, mould oil and surface retarders should be cleaned off. Ridges and fins left by shuttering imperfections should be removed before cleaning down. If the surface is not sufficiently keyed to offer proper adhesion, one of the keying methods described in **18.2.1** should be used.

18.2.4 Concrete blocks and concrete containing lightweight aggregate and autoclaved aerated concrete. Apart from ensuring that the surface is free from any substance likely to destroy the natural key for bedding or rendering, no special treatment is necessary. Any rendering should be applied through enched reinforcement and the recommendations for preparatory work made in 19.2 apply.

18.2.5 No-fines concrete. This usually requires no preparation other than as indicated in the general recommendations.

18.2.6 Lathing and mesh. Suitable metal lathing and mesh should be used and secured at intervals such that the applied rendering is rigid. Lathing and mesh made in other materials should be selected for their ability to bond with the applied rendering and, when suitably secured, to ensure its rigidity and to support its weight and that of the cladding.

18.2.7 Other backgrounds. A decision should be taken as to whether they are compatible with the intended cladding system and whether they have sufficient integral strength to support it.

18.3 Treatment of backgrounds to receive cladding by direct bedding

18.3.1 General. Cladding may be bedded directly to a background using 'thin-bed' or 'thick-bed' adhesives or cement/sand mortar as bedding materials. Methods of application and the suitability of backgrounds to accept these methods are described in section four and summarized in table 2.

Backgrounds should be free from any substance likely to inhibit adhesion.

Where the cladding is to be bedded in thin-bed adhesives (the thickness of which should not exceed 3 mm), the trueness of the background surface should be such that when checked with a 2 m straightedge, any gap behind the straightedge does not exceed 3 mm. Where the gap exceeds 3 mm, local correction of the background will be necessary or, alternatively, a thick-bed adhesive may be specified; this also applies to backgrounds not built accurately to a specified plane, for example not upright. Where thick-bed adhesives or cement/sand mortar are adopted, greater variations up to 6 mm can be tolerated.

When cement/sand bedding mortar is to be applied directly to a background, the surface should be treated as described in 18.2 for cement/sand rendering.

18.3.2 Sheets and boards. Plaster board, fibre building board, ordinary plywood and wood chipboard are not suitable as backgrounds for tiling and mosaics in external situations. Some types of asbestos sheeting and marine plywood may be used at low levels where the duration of the installation is expected to be limited but should be restricted to small areas; they are mainly used with framed or battened construction, which, together with the backs and edges of the sheets or boards, should be proofed against