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# मानक

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IS 4101-3 (1985): Code of Practice for External Cladding, Part 3: Wall Tiling and Mosaics [CED 13: Building Construction Practices including Painting, Varnishing and Allied Finishing]



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*Indian Standard*  
CODE OF PRACTICE FOR  
EXTERNAL CLADDING  
PART 3 WALL TILING AND MOSAICS  
( *First Revision* )

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INDIAN STANDARDS INSTITUTION  
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG  
NEW DELHI 110002

*Indian Standard*  
**CODE OF PRACTICE FOR  
EXTERNAL CLADDING**  
**PART 3 WALL TILING AND MOSAICS**  
*( First Revision )*

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*Indian Standard*  
**CODE OF PRACTICE FOR  
EXTERNAL CLADDING**  
**PART 3 WALL TILING AND MOSAICS**  
*( First Revision )*

**0. FOREWORD**

**0.1** This Indian Standard ( First Revision ) was adopted by the Indian Standards Institution on 23 December 1985, after the draft finalized by the Building Construction Practices Sectional Committee had been approved by the Civil Engineering Division Council.

**0.2** Wall tiles provide possibilities for a wide range of architectural treatment for external facing. Large varieties of tiles and new techniques for fixing tiles have been developed not only in foreign countries but in our country also. To frame complete guidance for all types of tiles is extremely difficult. However, an attempt has been made to make available the knowledge and experience in fixing wall tiling and mosaics for use by the engineers in this country.

**0.3** The methods of fixing wall tiles and mosaics are applicable to the above units of an area not exceeding 900 cm<sup>2</sup>. Larger shapes and sizes of tiles and mosaics generally require special methods which are not covered in this code. The tiling method specified applies to normal conditions only, that is, for the environment produced as a result of average climatic conditions of temperature and humidity. The recommendation regarding use of adhesives for bedding which is generally followed in the foreign countries has been included since such types of adhesives are not generally used in this country.

**0.4** This standard is prepared in three parts. Part 1 of this code is intended to provide guidance with regard to selection of materials and fixing techniques for facing with tiles of various stones. Part 2 is intended to provide guidance with regard to selection of materials and fixing techniques for facing with concrete slabs. Part 3 ( this part ) is intended to provide guidance with regard to selection of materials and fixing techniques for fixing wall tiling and mosaics.

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**0.5** This standard ( Part 3 ) was first published in 1969. The present revision has been undertaken to update the contents of the standard. The important changes include modification of requirements of thickness of floating coat and fixing details of tiles.

**0.6** For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS:2-1960\*. The number of significant places retained in the rounded off value should be same as that of the specified value in this standard.

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### 1. SCOPE

**1.1** This standard ( Part 3 ) covers requirements of fixing of wall tiles and mosaics on the exterior of the walls.

### 2. TERMINOLOGY

**2.0** For the purpose of this standard the following definitions shall apply.

**2.1 Thin-Bed** — A finished bedding coat not exceeding 3 mm thickness.

**2.2 Thick-Bed** — A finished bedding coat exceeding 3 mm thickness.

### 3. NECESSARY INFORMATION

**3.1** For efficient planning, design and execution of external facing work, detailed information on the following are necessary:

- a) Details of the walls to be faced, location of openings, service fittings, and
- b) Conditions of exposure and situation of use.

### 4. MATERIALS

**4.1** Tiles and mosaics for external cladding of walls shall be used as in 4.1.1 to 4.1.4.

**4.1.1 Terrazo Tiles** — Shall conform to the requirements of IS:1237-1980†.

**4.1.2 Ceramic Glazed Tiles** — Shall conform to the requirements of IS:777-1970‡.

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\*Rules for rounding off numerical values ( *revised* ).

†Specification for cement concrete flooring tiles ( *first revision* ).

‡Code of practice for glazed earthenware tiles ( *first revision* ).



**4.1.3 Unglazed Clay Facing Brick Tile** — Shall conform to the requirements of IS: 2691-1972\*.

**4.1.4 Mosaics** are of variety of shapes and sizes. It is recommended that before selecting a particular system the advice of the mosaics suppliers should be obtained as to the suitability of particular mosaics to the exposure conditions and fixing methods.

**4.2 Materials for mortar for floating coat ( see 7.2 ) and bedding ( see 8.1 )** shall be as given in 4.2.1 to 4.2.3.

**4.2.1 Cement** — Cement to be used for mortar shall be ordinary Portland cement conforming to IS: 269-1976† or masonry cement conforming to IS: 3466-1967‡.

**4.2.2 Lime** — Lime to be used for adding in floating coat shall conform to the requirements of IS: 712-1984§.

#### 4.2.3 Sand

**4.2.3.1 Sand** to be used for mortar bedding shall conform to the requirements of IS: 2116-1980||.

**4.2.3.2 Sand** to be used for floating coat and pointing shall conform to the requirements of IS: 1542-1977¶.

**4.3 Water** — Water shall be clean and containers used for storing water shall also be clean. Water shall generally conform to the requirements of 4.3 of IS: 456-1978\*\*.

**4.4 Battens for Tiling** — Battens shall be plane, and made equal to the combined thickness of the tile and fixing bed. Battens may be of timber metal, plastic or other similar materials. Straight edges shall be plane and true.

## 5. DESIGN CONSIDERATIONS

### 5.1 General

**5.1.1 Functions** — The functions of the external wall tiles and mosaics are:

- a) to obtain an overall architectural expression or to achieve a particular degree of effect,

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\*Code of practice for burnt clay facing bricks ( *first revision* ).

†Code of practice for ordinary, rapid-hardening and low heat Portland cement ( *third revision* ).

‡Code of practice for masonry cement ( *first revision* ).

§Code of practice for building limes ( *third revision* ).

||Code of practice for sand for masonry mortars ( *first revision* ).

¶Specification for sand for plaster ( *first revision* ).

\*\*Code of practice for plain and reinforced concrete ( *third revision* ).

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- b) to cover an unsightly surface,
- c) to increase the durability and reduce the maintenance of a structure, and
- d) to assist in protecting the structure against rain penetration and other weather conditions.

### **5.1.2 Choice of Tiles and Mosaics**

**5.1.2.1 Initial considerations** — The initial considerations in making a choice of tiling and mosaics, and the methods of fixing include the following factors that will assume different degrees of importance depending upon the circumstances and will affect not only the choice of the surface and the tile fixing medium but also the plaster coat or other preparatory treatment necessary before fixing as well as the design of architectural details in relation to the work:

- a) The appearance or effect desired,
- b) Exposure conditions and the degree of protection needed, and
- c) The nature of the background.

**5.1.2.2** The type of tile to be used should be decided early in the design period in order that the building or the relevant part of the building with its openings, etc, may be set out to the correct tile specified.

**5.1.2.3** The suitability of the mosaics or the situation should be established at the design stage. Door and window openings are normally designed to coincide with mosaics. Unsightly and awkward cut pieces may be avoided by suitable preparation.

### **5.2 Durability**

**5.2.1** Apart from the resistance to water penetration, the durability of tiling and mosaics is dependent on the following factors:

- a) The background, its nature and durability;
- b) The type of tile and its resistance to weathering;
- c) The method of fixing the tiles; and
- d) Pointing or grouting.

**5.2.2** Excessive temperature variations in surroundings will also cause cracks and bulges in the tiling. Dark coloured tiles will absorb heat readily. Where such effects are envisaged an adequate width of joints should be provided around each tile to accommodate thermal movement.

**5.2.3 Resistance to Water Penetration** — Water has access into the facing mainly through the joints and the tiles and mosaics themselves are impermeable unless the glaze is damaged and tile body is permeable. To prevent access the joints filling shall be impermeable, complete and without cracks. Once water has entered, it may affect the tile fixing and cause loss of adhesion and also enable frost action to develop. It may also promote chemical action in the background or may even penetrate through the background and cause dampness and damage to the internal finish. Proper waterproofing of joints consistent with exposure conditions supplemented with protection by projecting features may be considered. Waterproofing agents are sometimes incorporated in the proofing compounds and proprietary mixes are also used to achieve colour consistency of mortars with tiles or mosaics. In these cases, it shall be ensured that these additives do not adversely react with materials in the mortars or the tile and mosaics.

**5.3 Architectural Features** — Advantage shall be taken of special architectural features introduced to afford protection to tiling, wherever possible. On the other hand features shall also be so designed as not to leave adverse effect on the tiles and its decorative or protective properties.

**5.3.1 Parapet Walls** — Parapet walls with tile facings require careful treatment and such parapets should be protected by a coping and a damp-proof course immediately beneath it. To avoid staining coping should slope away from the tile face and beyond the inner face of the parapet and have an adequate throating or drip. The back of parapet walls shall preferably not be sealed so that moisture that may enter the wall may evaporate without hinderance.

**5.3.2 Sills** — The sill tiles shall be fixed at weathered angle. The sill shall be preferably of impervious material. The sill may project beyond the face of wall tiling and with a minimum of joints and with a throat or drip on the underside.

**5.3.3 Treatment at Base** — Tiling shall not be carried across the exposed edge of the horizontal damp-proof course at ground level without break, since it may transmit moisture past of the damp-proof course and make the latter ineffective; also movements of the building on the damp-proof course may damage the tiling.

**5.3.3.1** Where it is desired to have the tiling below as well as above the damp-proof course the latter shall be designed to project through the tiling to act as a flashing.

**5.3.3.2** Where tiling is not carried down to ground level or is otherwise broken horizontally, the bottom row of tiles shall be properly supported and in such a way as to throw water clear of exposed wall beneath.

**5.3.4 External Corners** — Tiling on external corners at ground level or at other positions is vulnerable to damage. In conditions of usage which may introduce a substantial risk of mechanical damage, say from mobile plant, suitably robust corner pieces should protect the tiling or be substituted for it.

**5.4 Provision of Movement Joints** — Compressive stresses will be set up in the tiling or mosaic as a result of movements due to variations in strength and drying shrinkage of the backgrounds, as well as by the vertical settlement of tiling or mosaic; and these will result in loss of adhesion and bulging. Movement joints may be provided to accommodate such movements. Normally these joints shall be at the level of every storey height horizontally and approximately at 3 metres spacing vertically. They shall coincide with structural material changes such as top of slab for horizontal joint.

**5.4.1** Movement joints shall be extended to the depth of the tile and bed, and shall be minimum 6 mm wide. The joints shall be filled with cement mortar with about 15 percent gauging with lime putty.

## **5.5 Suitability of Background**

**5.5.1** Dense strong and smooth materials, such as high density clay bricks and blocks; dense concrete precast or cast *in-situ*, stone, glazed bricks or glazed tiles, have low porosity, little suction and have smooth surfaces which offer no mechanical key. Where floating coat is used artificial means for ensuring good bonds are often necessary. Dense concrete will also have problems of drying shrinkages according to mix quality and reinforcement.

**5.5.2** Moderately strong and porous clay bricks medium-density concrete blocks and soft stone have relatively high suction and generally provide mechanical key and adhesion for the floating coat. Drying shrinkage of concrete is variable and should be taken into consideration.

**5.5.3** For moderately weak materials like lightweight concrete, aerated concrete and bricks of low strength careful selection of floating coats will be necessary and the floating coat shall not be stronger than the background as otherwise differential shrinkage is liable to shear the surface of the background.

**5.5.4** For no-fines concrete which has large voids and affords efficient mechanical key for floating coat, drying shrinkage will be low to moderate.

**5.5.5** Metal lathing, asbestos cement sheet, exterior grade plywood and similar backgrounds shall be so designed as to ensure a rigid surface to support the tiles. Old plaster work may be too weak in itself or be too weakly adhering to the background to support tiles.

## **6. PREPARATION OF BACKGROUNDS TO RECEIVE A FLOATING COAT**

**6.1** Sufficient time should have elapsed for complete initial drying and shrinkage of the background before application of floating coat. The surface to be floated shall be properly cleaned from dust and loose particles. If the surface proposed to be covered with tiles is already covered, the same shall be removed till brickwork or concrete, etc, below is exposed.

**6.2** The surface wetted down to control suction shall not be allowed to dry before the floating coat is applied; the floating shall keep pace with wetting or the surface rewetted as necessary. Efflorescence and laitance shall be removed preferably by dry brushing.

**6.3** Surfaces contaminated with oil, grease and other water repellent materials that destroy the natural key for the floating coat should be treated specially, by fixing metal lathing or wire netting to support floating coat independently, or by thorough hacking and deep raking of joints. Hacking is not effective unless the surface is adequately keyed throughout. At least one-half of any smooth surface shall be removed to a depth of 3 mm. This may be done by hand or mechanically.

**6.3.1** Regarding use of bonding agents sufficient long-term experience is not yet available; where they are used the manufacturer's instruction may be followed.

**6.3.2** The surface of brickwork or other solid background that is dis-integrating or is so weak that it is unlikely to support a floating coat should be covered with firmly fixed metal lathing or wire netting.

## **7. APPLICATION OF FLOATING COAT FOR TILES AND MOSAICS**

**7.1 General** — The purpose of the floating coat or rendering is to form a surface suitable for the application of tiling when the background is unsuitable for the direct fixing of tiles. It is essential that the floating coat be suited to the background to which it is applied and to the method used for fixing the tiles, where the mix for the floating coat contains an integral waterproofing material and the tiles are to be fixed in sand and cement mortar, then a suction coat of cement must be applied to the waterproofed floating coat within 24 hours.

### **7.2 Mortar Mix for Floating Coat**

**7.2.1** On dense strong and smooth or moderately strong and porous surfaces, such as high density clay bricks or blocks, dense concrete either precast or *in-situ* and stone, the floating coat shall consist of Portland cement and sand in proportion not stronger than 1 : 3 by volume and not

weaker than 1 : 4. The floating coat shall not be mere strongly gauges with cement as strong mixes increase the drying shrinkage forces set up in the tiling and thus encourage defects. Too weak a mix shall also be avoided, as otherwise the floating coat may be too weak to support the tile bedding mortar.

**7.2.1.1** To improve the workability of the floating coat and thus to aid application and finishing, a small proportion of hydrated lime may be incorporated in the mix. Thus, for a mix of three parts of sand to one part of cement up to half part of lime may be added by volume.

**7.2.2** On moderately weak and porous backgrounds such as lightweight aggregate concrete, aerated concrete and some bricks of relatively low strength, the floating coat shall consist of Portland cement and sand in the proportion 1 : 4 to 5 by volume. To improve workability of one-fourth, or up to half part of lime by volume may be added.

**7.2.3** *For Mixed Backgrounds* — Where tiling is continuous across background of varying types their differential movement may induce cracking. This risk may be minimized by fixing metal lathing or wire netting across the junction so that it is incorporated in the floating coat. Alternatively, it may be convenient and more satisfactory to incorporate a movement joint in the tiling at such positions ( *see 5.4* ).

### 7.3 Thickness of Floating Coat

**7.3.1** The thickness of coat shall be at least 20 mm and built up in two or more coats, each not more than 10 mm thick. Each coat shall be allowed to dry out before a further coat is applied to avoid cumulative stresses being set up. A strong coat shall not be applied over a weaker one which would be unable to restrain its movements.

**7.3.2** When fixing is done by sand and cement bedding, the floating coat should be plumb and even the unevenness, if any, shall not exceed 1 in 600. The surface of the floating coat shall not be over trowelled and preferably scratched to afford a key for the bedding mortar.

## 8. BEDDING MATERIAL FOR TILES AND MOSAICS

**8.1** The bedding materials may be any one of the following.

### **8.1.1** *Sand and Cement Mortar*

**8.1.2** *Sand and Cement Mortar with Additives* — The mix for bedding material shall contain not less than 3 parts and not more than 4 parts of the sand to one part of cement by volume. The additives ( such as plasticizers, waterproofs and cement containing such materials ) may be added. The mortar shall be prepared in accordance with IS: 2250-1981\*.

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\*Code of practice for preparation and use of masonry mortars ( *first revision* ).

**8.2** While using sand cement mortar, the fixing bed and the preparatory work leading up to the stage when the wall is ready to receive the tiles shall be carried out properly and the final floating coat shall be true to plumb. Before tiling is commenced the lack of adhesion of floating coats shall be checked and ensured that no part of the rendering has a hollow ring indicating lack of adhesion to the wall behind. The floating coat shall be completed at least one week before tile fixing begins and shall be free from visible moisture.

## **9. FIXING OF TILES**

**9.1 Preparation** — Surface shall be properly prepared to receive tiles and it shall be true and level.

**9.1.1** Tiles with non-porous bodies need not be soaked. Tiles with porous bodies will be completely immersed in clean water in clean containers for at least half an hour before using. After soaking, the tiles should be removed from water and stacked tightly together on a clean surface to drain water away. They should be fixed as soon as the surface water has drained away.

**9.2 Wetting of the Floating Coat** — Where necessary before tiling begins and bedding mix applied on it, the dry floating coat shall be wetted just sufficiently to prevent it from absorbing water from the bedding mix.

**9.3 Fixing** — The bedding mortar shall be applied at a time over such an area as can be covered by tiles before the initial set of mortar. The bedding mortar shall be levelled properly and a skin of neat Portland cement shall be trowelled over it immediately before fixing the tiles. The resultant thickness of the bed behind the tiles shall generally be 6 mm but not more than 12 mm thick. As soon as bedding mortar hardens sufficiently all tiles should be firmly secured in place and gently tapped so as to bring finished surface to the desired level. Where full size tiles cannot be fixed these shall be cut (sawn) to the required size and their edges rubbed smooth to ensure a straight and true joint. Tiles which are fixed in the wall adjoining the floor shall enter not less than 12 mm under the plaster skirting or dado. The junction between wall plaster and tile work shall be finished neatly and without waviness. Surplus grout or mortar which oozes out of joints should be mopped before it hardens and the face of tiles cleared properly. Uniform spaces between tiles may be obtained by using insertable spacer page, which shall be inserted as the work proceeds. The spaces shall not exceed 2 mm. Any adjustment to a tile shall be made within about ten minutes of its being fixed. A straight edge shall be used to ensure that the tiles surface is flat and true. Cleaning off shall not be commenced before  $1\frac{1}{2}$  to 2 hours from the time of regulating of the tile surface. When the surface becomes dry, same be mopped with powdered lime taken in a clean soft cloth.

## **9.4 Grouting or Pointing of Tiles**

**9.4.1 General** — It is most essential in order to ensure a properly finished job that particular attention be given to the grouting or pointing of the tiling. Grouting or pointing, if time permits, should not be carried out until the day after the tiles have been fixed. The general properties of an ideal grouting or pointing mix are :

- a) Low shrinkage;
- b) Low compressive strength;
- c) Good adhesion;
- d) Impermeability, and
- e) Easy cleaning.

**9.4.2 Grouting or pointing mixes of grey or white Portland cement** mixed with clean water to the required consistency is satisfactory. A waterproofing agent may be incorporated in the pointing or grouting mix, but where wide joints are specified, consideration may be given to the use of proprietary compounds in order to avoid variations in colour. Adhesion of waterproofing is given in 5.2.3.

**9.4.3 Grouting ( Joints up to 5 mm Wide )** — The grouting mix should be applied to as large an area as may be worked before hardening commences, which will depend on climatic conditions. The grout should be applied with a squeegee working back and forth over the area until all the joints are completely filled, after which all surplus grout should be removed from the tiles with a damp cloth and the tiles subsequently polished with a dry cloth.

**9.4.4 Pointing ( Joints of 5 mm Wide and Over )** — The pointing mix may be similar to that used for grouting, except that when using cement, a small proportion of fine sand should be added to the mix to facilitate application. Pointing shall fill completely the void between tiles and bed by applying the pointing compound with a suitable pointing tool. The surplus material should afterwards be cleaned off.

**9.5 Tolerances** — The surface of the finished tiling should not vary from the general plane by more than 1 in 200.

## **10. FIXING OF CERAMIC MOSAICS**

**10.1 Preparation** — To facilitate ease of handling, mosaics may be assembled in the form of sheets or varying mixes; the separate pieces of mosaics being glued either face side down to paper or bedding side down to nylon adhesive strips or nylon fabric net or other suitable material. When using



the paper faced type, the paper shall be left clear of the edges to allow for adjustment when fixing the sheets. The paper shall be of a type which is easily removable after fixing has taken place.

**10.2 Setting Out** — It shall be ensured that the area to be covered by mosaics is true to allow a correct and even thickness of bedding mortar and mosaics. All openings in walls for windows, doors, etc, shall be checked so that no difficulty will arise in the setting out. If it is found that the full size mosaic sheets cannot be used, they may be easily cut to the required size. Where mosaic sheets are to be applied to a floating coat, the surface shall be slightly scratched and finished with a wood float.

**10.3 Application of the Bedding Mortar** — The floated coat shall first be examined to ensure that it is firmly bonded to the background. The floated coat shall then be brushed down with a dry, stiff brush to remove any dust, mortar dripping or contamination left by other trades. If suction is found to be excessive, it shall be relieved by damping the surface with clean water. The bedding mortar, may then be applied to the floating coat to a thickness of not more than 10 mm.

**10.4 Pre-grouting** — Before bedding, the fixing side of the mosaic sheet shall be grouted with a neat cement slurry of a creamy consistency and of the colour of the final grout. This process shall be carried out as the sheets are fixed.

**10.5 Final Grout** — After the sheets have been firmly beaten in the facing paper and glue removed and final straightening has been completed a grout shall be rubbed over the surface to fill voids in the joints and then be cleaned down. After the cement in the joints has hardened the whole of the surface may be washed down with a solution of 10 percent hydrochloric acid and 90 percent water and finally with clean water.

## **11. FIXING OF MARBLE MOSAICS**

**11.1** The method of fixing shall be the same as in 10, with the exception that the back of the mosaics after applying the cement grout into the joints shall be covered with a thin layer of two parts of fine sand and one part cement to the level of the thickness. This is due to the variation in thickness of the marble mosaics.

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SHRI J. R. MURTHY	Engineer-in-Chief's Branch, Army Headquarters, New Delhi
SHRI L. R. LALLA ( Alternate )	
SHRI B. NATARAJAN	Kent Ceramic Tiles Co Pvt Ltd, Madras
SHRI SUBRATO RAY	Balmer Lawrie and Co Ltd, Calcutta
SHRI K. S. SRINIVASAN	National Buildings Organization, New Delhi
SHRI A. K. LAL ( Alternate )	
SHRI K. SURYANARAYANAN	Indian Aluminium Company Ltd, Calcutta
SHRI ANJAN SEN ( Alternate )	



# INDIAN STANDARDS INSTITUTION

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Telegrams: Manaksanstha  
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## Regional Offices:

## Telephones

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†Eastern : 1/14 C. I. T. Scheme VII M, V. I. P. Road,  
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Southern : C. I. T. Campus, MADRAS 600113

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## Inspection Office (With Sale Point):

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