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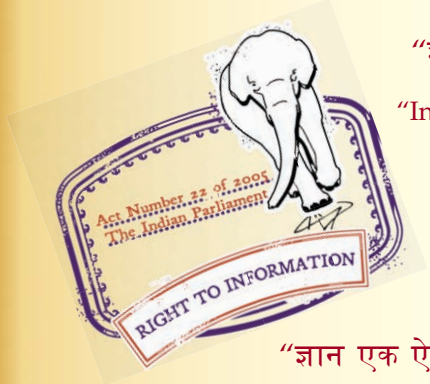
IS 2402 (1963): Code of Practice for External Rendered Finishes [CED 5: Flooring, Wall Finishing and Roofing]



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"Knowledge is such a treasure which cannot be stolen"

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CODE OF PRACTICE FOR EXTERNAL RENDERED FINISHES

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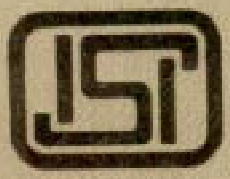

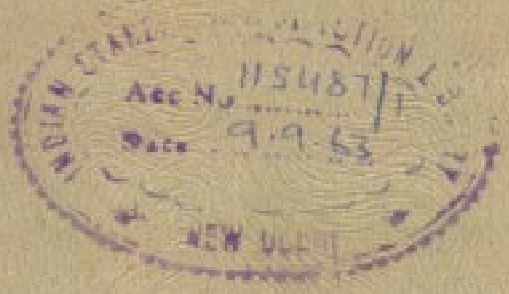

INDIAN STANDARDS INSTITUTION
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August 1963

Indian Standard

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CONTENTS

Indian Standard

CODE OF PRACTICE FOR EXTERNAL RENDERED FINISHES

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 29 June 1963, after the draft finalized by the Concrete, Plaster and Tiled Finishes Sectional Committee had been approved by the Building Division Council.

0.2 'Rendering' denotes generally external plaster and allied finishes, plain or textured, applied for the purpose of protection and decoration. Rendered finish can be designed for performance suited to the different situations of use, whether it is severe or moderate exposure to rain; whether it is dusty, clear or corrosive atmosphere; or whether it is subject to large variations in temperature or other climatic cycles. The binder in the rendering mix can be varied by adjusting proportions of cement, lime or other ingredients; the types of aggregates can be chosen for special durability and finishing characteristics and adjustments made in their sizes and grading; different textures and finishes can be adopted, such as scraped, roughcast, pebble-dash, etc; and the techniques of application can be varied to obtain special effects, increased durability and better performance.

0.3 This standard is intended to give guidance with regard to the selection of rendered finishes to suit different backgrounds and conditions of exposure, and with regard to the design of their composition and methods of application so as to obtain a finish that gives satisfactory performance without undue maintenance and repairs.

0.4 The Sectional Committee responsible for the preparation of this standard has taken into consideration the views of producers, consumers and technologists and has related the standard to the manufacturing and trade practices followed in the country in this field. Due weightage has also been given to the need for international co-ordination among standards prevailing in different countries of the world. These considerations led the Sectional Committee to derive assistance from B.S. CP 221 : 1960 External Rendered Finishes issued by the British Standards Institution and National Building Studies Bulletin No. 10, External Rendered Finishes for Walls, issued by the Building Research Station, United Kingdom.

0.5 This standard is one of a series of Indian Standards covering plaster finishes. Other standards in the series are:

IS : 1661-1960 CODE OF PRACTICE FOR CEMENT AND CEMENT-LIME PLASTER FINISHES ON WALLS AND CEILINGS

*IS : 2394- CODE OF PRACTICE FOR APPLICATION OF LIME PLASTER FINISH

0.6 Wherever a reference to any Indian Standard appears in this standard, it shall be taken as a reference to its latest version.

0.7 Metric system has been adopted in India and all quantities and dimensions in the standard have been given in this system.

0.8 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 Rules for Rounding Off Numerical Values (*Revised*). The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

0.9 This standard is intended chiefly to cover the technical provisions relating to external rendered finishes, and it does not cover all the necessary provisions of a contract.

1. SCOPE

1.1 This standard covers the application of external rendered finishes for all normal types of backgrounds. It also specifies the materials to be used for renderings and the minimum preparation of background for application of finish.

1.2 It does not cover plain plaster finishes required for internal walls and ceilings, which are dealt with in a separate standard, namely, IS : 1661-1960 Code of Practice for Cement and Cement-Lime Plaster Finishes on Walls and Ceilings.

2. TERMINOLOGY

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

2.1 General

Background — The material or combination of materials to which the first coat of the rendering is applied.

*Under preparation.

Efflorescence — Salts deposited on the surface of building materials on drying.

Firring — Light wood or metal battens fixed to solid backgrounds for subsequent attachment of expanded metal or sheet materials.

Key — Indentations, openings, grooves or other irregularities on the surface of the background or undercoat into or through which the rendering material can be pressed in such a way that it will bond to the surface.

Thickness of a Coat — The average thickness of a particular coat excluding the thickness of material required for filling and levelling up the background or for filling the raked joints.

Workability — The quality of a rendering mix in respect of all the properties affecting its behaviour during application. The operative's opinion of workability is influenced by the flow properties, the cohesiveness of the mix and its retentivity of moisture against the suction of the background.

2.2 Site Operations

Back Rendering — The coat of rendering material applied on the inner face of the lathing.

Filling — The process of filling in hollow places in a solid background before the rendering is applied. It may also be employed where projections or extra thicknesses are required.

Final or Finishing Coat — The final continuous coat of rendering material. In dry-dash finishes, it is the coat on to which the dash is thrown while the coat is still soft. In roughcast or machine applied finishes it is the last coat thrown on to complete the finish.

Floating Coat — The undercoat immediately preceding the final or finishing coat.

Rendering or Base Coat — The first undercoat of rendering material applied directly to the prepared background.

2.3 Finishing Treatment

Dry-dash (*Pebble-dash*) — A rough finish in which small pebbles or crushed stones of suitable size (generally from 10 to 20 mm) are thrown on to a freshly applied final coat of mortar, and left exposed.

Machine-Applied Finishes — A variety of finishes of which the final coat is applied by means of hand or power-operated machines which spatter or throw the material on to the wall. The roughness of

the finished surface varies with the material used and the type of machine.

Roughcast — A finish in which the final coat, containing a proportion of fairly coarse aggregate, is thrown on as a wet mix and is left in the rough condition. The texture desired is regulated by the size of the coarse aggregate which is generally of size between 6 to 12 mm.

Scraped Finish — A finish in which the final coat, after being levelled and allowed to stiffen for a few hours, is scraped with a steel straight edge, old saw blade or other tools to remove the surface skin.

Textured Finishes — Finishes having ornamental, patterned or textured surfaces produced by treatment of the freshly applied final coat with various tools. The horizontal or vertical ribbed texture, the fan texture, torn texture and the English cottage texture are some of the variations attained by such treatment.

Typical illustrations of different finishing treatments are given in Fig. 1 to 5.

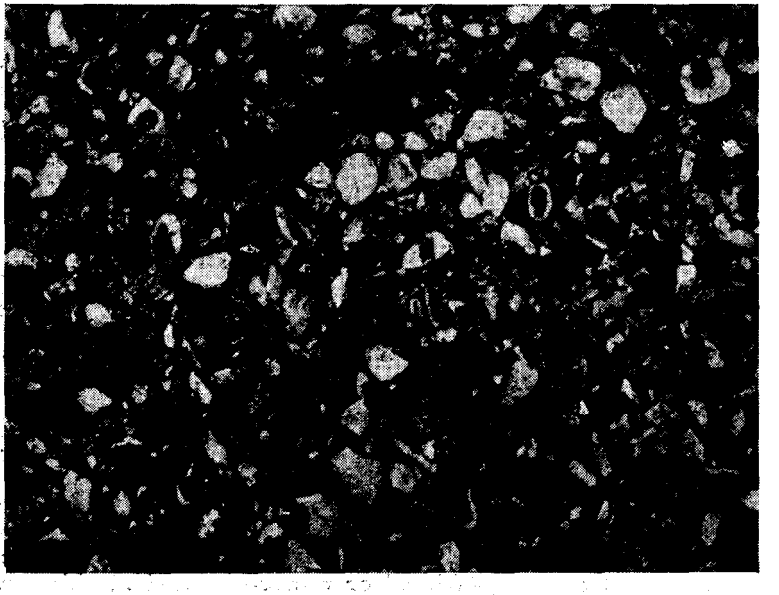


FIG. 1 PEBBLE-DASH

FIG. 2 ROUGHCAST

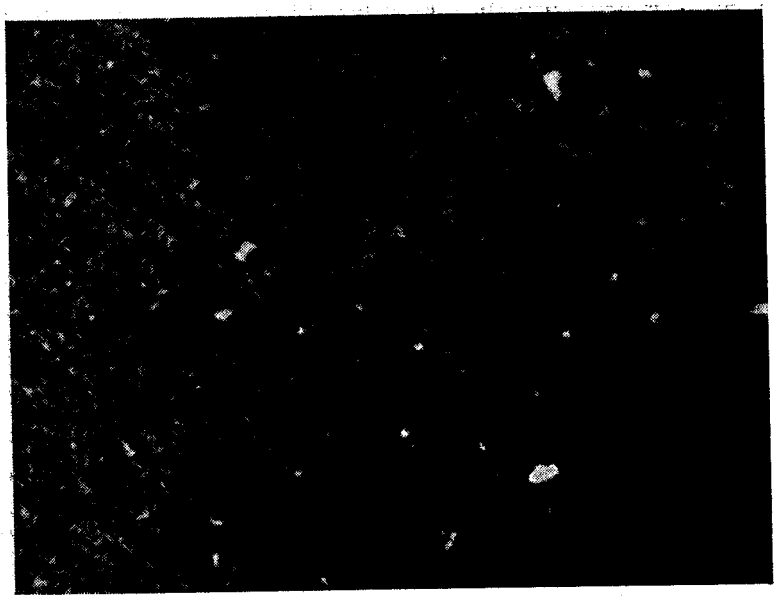


FIG. 3 SCRAPED FINISH

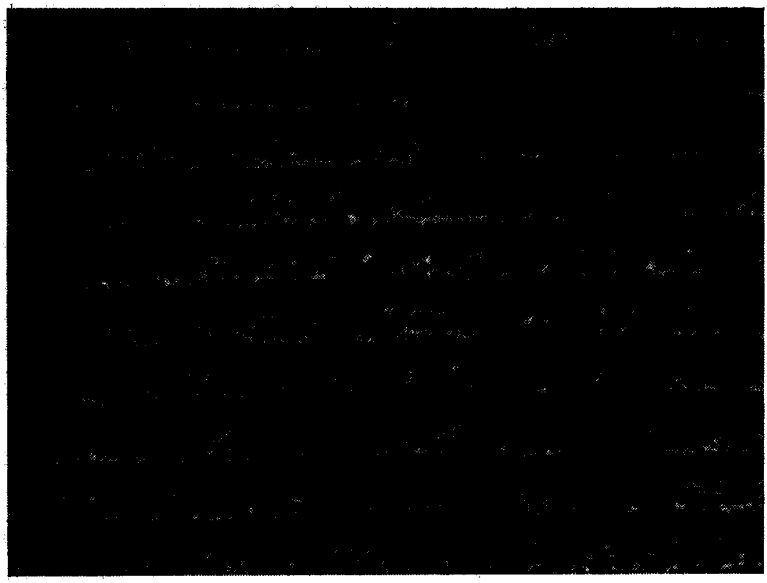


FIG. 4A RIBBED TEXTURE

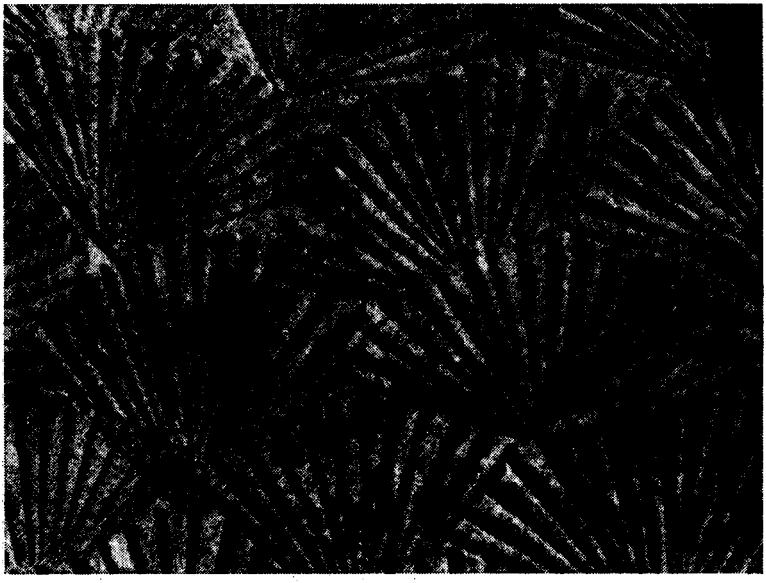


FIG. 4B FAN TEXTURE

FIG. 4C ENGLISH COTTAGE TEXTURE

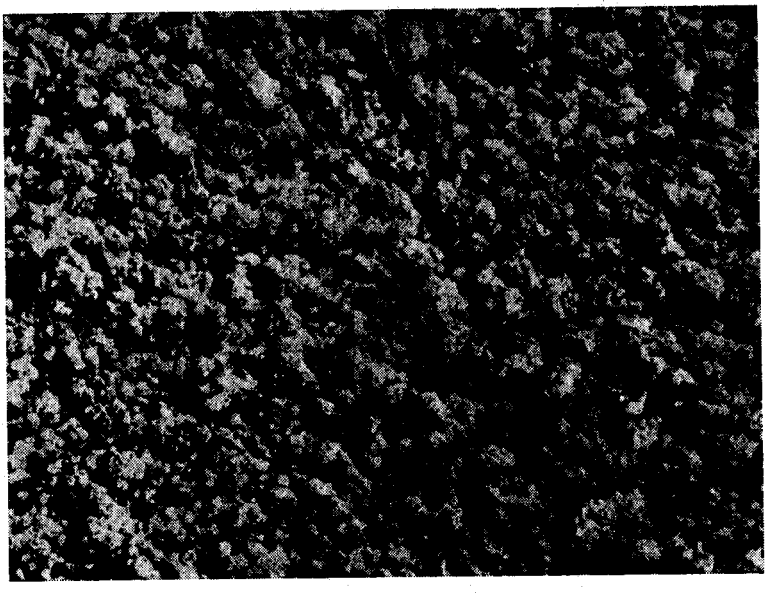


FIG. 5A MACHINE-THROWN FINISH : COARSE TEXTURE

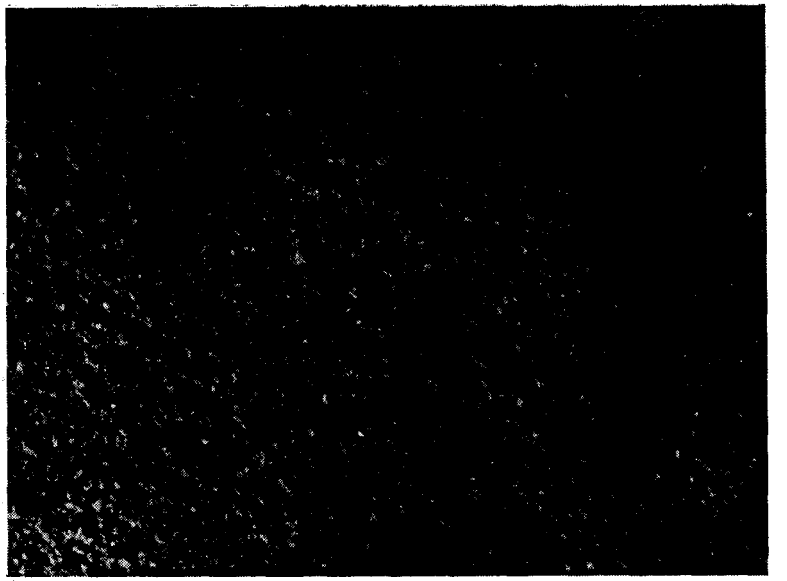


FIG. 5B MACHINE-THROWN FINISH : MEDIUM FINE TEXTURE

2.4 Characteristic Defects

Crazing — The development of hair cracks on a surface, usually forming an irregular pattern.

3. NECESSARY INFORMATION

3.1 For the satisfactory selection of materials for rendering, their preparation and application, the following information will be necessary and shall be furnished to those responsible for the work:

a) Types of surface, such as brick, stone or concrete over which the rendering is proposed to be applied. Constructional details will have to be suitably adopted to the background, particularly the type and the extent of preparation of the background;

b) Area and type of external rendered finish;

c) Nature of the background, namely (1) whether it contains soluble sulphates and (2) the time elapsed since its construction to know the extent to which the background should be further dried before application of the rendering;

d) Atmospheric conditions in the locality, namely, whether carrying dust, acidic fumes, etc, and also the extent of exposure to rain and wind;

e) Drawings giving details of the finish at junctions to doors, windows and other openings, type of cornice, arris and return treatments; and

f) Details of decorative finishes that are to be applied over the rendering.

3.2 Necessary drawings and instructions for preparatory work shall also be given.

3.3 Arrangements shall be made for proper exchange of information and co-ordination between those engaged in the rendering work and all those whose work will be affected.

4. MATERIALS, TOOLS AND ACCESSORIES

4.1 Cement — This shall be ordinary cement conforming to IS : 269-1958 Specification for Ordinary, Rapid Hardening and Low Heat Portland Cement (*Revised*), or blastfurnace slag cement conforming to IS : 455-1962 Specification for Portland Blastfurnace Slag Cement (*Revised*), or white cement of approved quality.

4.1.1 Coloured cement may be either ready mixed material or may be obtained by mixing pigments and cement at site. The pigments to be mixed with cement shall conform to Appendix A of IS : 2114-1962 Code of Practice for Laying *In-Situ* Terrazzo Floor Finish.

4.2 Sand — This shall conform to IS : 1542-1960 Specification for Sand for Plaster. For white or coloured renderings, only quartz or silica sand shall be used.

4.2.1 For some textured finishes, such as those produced by treatment of the freshly applied final or finishing coat with a tool, it may be desirable to remove the coarser particles (for example, by screening through 3·35-mm IS Sieve or 2·36-mm IS Sieve) while for others, such as the torn texture, a slightly larger proportion of material coarser than 4·75-mm IS Sieve may be needed.

4.3 Aggregates — All aggregates other than sand (*see* **4.2**) shall conform to IS : 383-1963 Specification for Coarse and Fine Aggregates from Natural Sources for Concrete (*Revised*).

4.3.1 For roughcast, crushed stone or fine gravel up to 12 mm maximum may be used in the finishing coat. The grading and maximum size will vary according to the texture required and the type of stone; an aggregate of the desired grading may be obtained either by using

a mixture of stone or gravel with sand or by using crushed stone graded from the maximum down to dust. The proportion of coarse material (over 4·75-mm IS Sieve) to fines shall be between 1 : 1 and 1 : 2 by volume.

4.4 Lime — This shall conform to IS : 712-1956 Specification for Building Limes.

4.5 Water — Water used for mixing shall be clean, free from deleterious matter and unusual proportions of dissolved salts. Sea water, estuarine water or brakish water shall not be used. Water fit for drinking is normally suitable; in case of doubt, an analysis shall be made.

4.6 Fibrous Materials — Certain natural fibres, such as flax, sisal, manila, jute, hemp, and coconut fibres may be used for incorporation in the mortar. They shall be clean, dry and free from oil. Mineral fibres like asbestos may also be used.

4.7 Metal Lathing — Different varieties of metal lathings are available as proprietary products, and only approved variety shall be used. Typical illustrations for different types are shown in Fig. 6. When used as a reinforcement or to provide a key on solid backgrounds, only the plain expanded type without ribs shall be used.

4.8 Expanded Metal — Where used as background for rendering, expanded metal shall comply with the requirements of IS : 412-1962 Specification for Expanded Metal Steel Sheets for General Purposes (*Revised*).

4.9 Tools and Accessories — Tools and accessories used for rendering may advantageously conform to the relevant provisions of IS : 1630-1960 Specification for Mason's Tools for Plaster Work and Pointing Work.

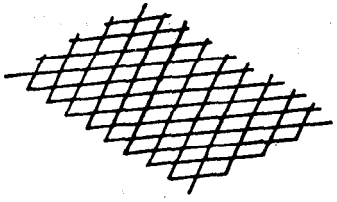
5. CARE OF MATERIALS, TOOLS AND ACCESSORIES

5.1 Materials — These shall be stored and handled in accordance with the relevant provisions of the specifications for materials mentioned in **4.**

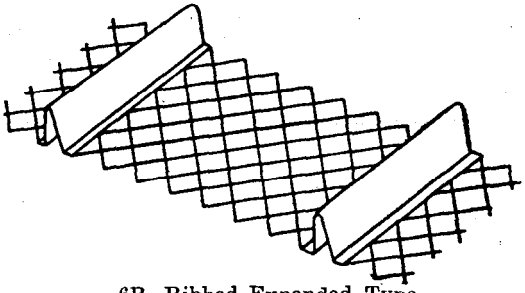
5.1.1 Lime shall be stored as specified in IS : 712-1956 Specification for Building Limes.

5.1.2 Sand shall be stored under clean conditions to prevent contamination by soil or other deleterious substances.

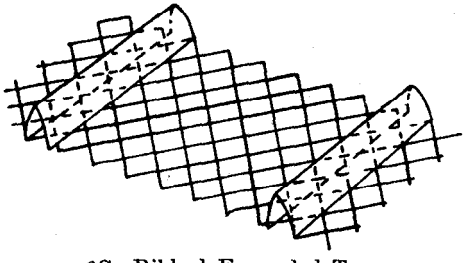
5.2 Tools and Accessories — All tools shall be cleaned by scraping and washing at the end of each day's work, or after use with different



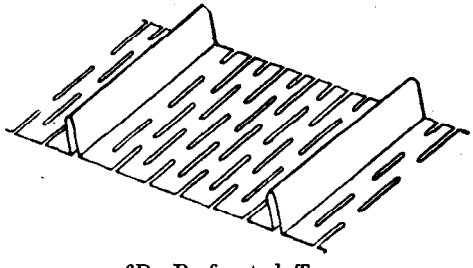
6A Plain Expanded Type



6B Ribbed Expanded Type
(ribs integral)



6C Ribbed Expanded Type
(ribs attached subsequent
to expansion of the metal)



6D Perforated Type

FIG. 6 TYPICAL ILLUSTRATIONS OF METAL LATHING

materials. Metal tools shall be cleaned and greased after each operation. All tools shall be examined and thoroughly cleaned before plastering is begun. Cleanliness is particularly important with cement plasters, where contamination with set material can seriously affect the performance as well as reduce effective life of the tools.

6. DESIGN CONSIDERATIONS

6.1 Functions of External Renderings — The functions of external renderings are:

a) to increase the durability of a wall, pier, column or similar structures and to reduce maintenance costs;

b) to prevent penetration of moisture into the structure; and

c) to cover an unsightly surface or to obtain a particular decorative effect.

6.1.1 The various factors that will affect the choice of the type of treatment are as mentioned in items (a) to (f) under **3.1**. These factors will assume varied degrees of importance in different circumstances and will affect the mix used, the method of application and finishing, the preparatory treatment to be given to the background and the design of architectural features and other details in relation to the rendering.

6.1.2 Other performance factors which are important are as follows:

a) Durability;

b) Adhesion between the rendering and the background, and between the various coats of the rendering; and

c) Resistance to cracking and crazing.

6.2 Suitability of Various Types of Rendered Finishes — The suitability of various methods of finishing renderings for various conditions is explained in Table I, and also generally in **6.2.1** to **6.2.4**.

6.2.1 *Trowelled or Floated Plain Finishes* — Steel trowelled finishes are not recommended for external renderings. Plain floated finishes require a high standard of workmanship to minimize the risk of cracking, crazing and irregular discoloration.

6.2.2 *Scraped or Textured Finishes, Hand-Applied* — Scraped or textured finishes are generally less liable to crack and craze than plain finishes and are easier to bring to a uniform appearance; this is especially important when coloured renderings are used. Although offering more lodgement for dirt, a rough texture tends to an evenness of discoloration, which is less apparent than with a smoother finish. Also the distribution of the flow of rain water over the surface reduces the risk of penetration through the rendering.

TABLE I SUITABILITY OF THE VARIOUS METHODS OF FINISHING RENDERINGS FOR VARIOUS CONDITIONS

(*Clause* 6.2)

TREATMENT	SUITABILITY ON VARIOUS BACKING MATERIALS	SUITABILITY FOR VARIOUS ENVIRONMENTS	SUITABILITY FOR VARIOUS EXPOSURE CONDITIONS	REMARKS
(1)	(2)	(3)	(4)	(5)
Pebble-dash or dry-dash Roughcast	Not suitable on weak types of brick or lightweight concrete	All areas, but particularly suitable for situations subjected to heavy rainfall and strong winds	Particularly suitable for severe conditions	Requires little maintenance except for fungus growth
Scraped finishes Textured finishes	All backing materials	All areas, but coarser finishes less suitable in the dirtier urban atmosphere	All conditions	Greater freedom from crazing and patchiness of appearance than smooth finishes
Smooth (Floated) finishes	All backing materials	All areas (*see* 'remarks')	All conditions	This type is most likely to develop defects, including crazing, cracking and patchiness of appearance
Machine applied finishes	All backing materials	Often less suitable for industrial areas and localities exposed to dust storms as they show dirt rather badly	All conditions	Do not craze but become patchy or streaky under certain conditions
White or light colours in any of above finishes	All backing materials	Less suitable for industrial areas	All conditions	Will probably require some maintenance to keep good appearance in urban areas

6.2.3 *Hand-Thrown Finishes, Roughcast and Dry-dash, etc* — Hand-thrown finishes, roughcast and dry-dash have all the advantages of scraped or textured finishes. Under severe conditions of exposure these are more satisfactory from the points of view of weather proofness, durability and resistance to cracking and crazing than the types mentioned in **6.2.1** and **6.2.2**.

6.2.4 *Machine-Applied Finishes* — These are of various types, mainly proprietary materials and processes operated by specialists. The types are as follows:

a) *Finishes in which the material is thrown at random* — These have an open porous structure, behave similarly to hand-applied scraped finishes and are equal to the latter and to hand-thrown finishes in water-proofness, durability and resistance to cracking and crazing.

b) *Finishes which are applied by gun or spray* — These give low density porous finishes.

However, there are some finishes which are also applied by means of a cement gun, under pressure, but produce a finish somewhat similar in appearance to roughcast but less attractive. They are generally more dense and, therefore, give very effective protection. For this reason, they are generally used in circumstances where protection is the sole requirement.

6.3 Nature of Background in Relation to Choice of Rendering

6.3.1 Broadly the background may be classified under following types so far as application of rendering is concerned:

a) Dense, strong and smooth materials;

b) Moderately strong and porous materials;

c) Moderately weak and porous materials;

d) No-fines concrete; and

e) Lathing or other similar backing materials.

6.3.2 The characteristics of these types of background are explained in Table II.

6.4 Resistance to Water Penetration

6.4.1 Water may penetrate either through the pores of a rendering or through cracks or both. The extent of penetration through the pores will depend upon the permeability of the various coats, upon the relative suction of the rendering and the backing and also upon the quantity of water at any one point upon the surface.

TABLE II BACKGROUNDS FOR RENDERINGS

(Clause 6.3.2)

Sl No.	Backing Materials	Strength	Porosity and Suction	Mechanical Key and Adhesion	Resistance to Penetration, Protection Required
1	Poured cement concrete	Strong	Low	Roughening, moistening and sometime treating the surface with cement and sand grout (1 : 1) is necessary	Sufficient resistance; no further treatment apart from rendering
2	Cement concrete blocks				
3	Bricks, very dense type; stones				
4	Bricks, Ordinary Porous Type	Moderately strong	High	Satisfactory; if suction is irregular use cement and sand mix 1 : 1 over the surface	Sufficient resistance; no further treatment apart from rendering
5	No-fines concrete	Sometimes weak	Large voids, few small pores, capillarity absent; suction low	Very satisfactory	—
6	Lathing	Shall be strengthened against subsequent movements	—	Purpose is to provide key	Two coats of rendering are necessary. First coat shall be of relatively impervious mix

6.4.2 Rain falling upon a relatively smooth surface with little or no absorption does not distribute itself evenly, but tends to run down the surface in streaks. A rough surface, on the other hand, will break up the flow and so avoid the concentration of water at any one point.

6.4.3 Where cracks occur, particularly in a dense and impermeable rendering, water may enter and find its way between the rendering and the background, or directly into the background. When this happens, the water is liable to cause trouble in one or more of several ways. It may cause loss of adhesion, further cracking or complete disintegration of the rendering through either frost action or the action upon the cement of soluble sulphates that may be present in the walling material; it may soak through the wall and cause dampness, loss of adhesion or disintegration of plaster work inside; or it may have other deleterious effects.

6.5 Durability — The durability of the external rendering is dependent upon the factors mentioned in **6.5.1** to **6.5.5.**

6.5.1 *Nature of Background and its Durability* — The durability of the various types of background to which renderings may be applied is dealt with in the relevant codes of practice dealing with those materials or types of structures. The influence of the nature of the background upon the type of rendering recommended is dealt with in **6.3.**

6.5.2 *Presence of Soluble Salts (Sulphates) in Backgrounds*

6.5.2.1 Soluble salts, particularly sulphates, may sometimes occur in new backgrounds consisting of some types of clay brick or block, or in old work in a wider range of backgrounds, the salts then having been derived from extraneous sources, condensation in chimneys being one of the most common sources. Whatever the source, such salts have harmful effects which may lead to cracking and loss of adhesion of any rendering. The risk of defects arising from this cause is much greater if the background at any time becomes damp, since the chemical reactions between the sulphates and constituents of the cement, which give rise to the defects, progress only under moist conditions and the salts diffuse to the surface only in solution.

6.5.2.2 Where such salts are likely to be present, the rendering shall be avoided on any background liable to get damp, for example, retaining walls, work below damp-proof course at ground level, and chimney stacks. Rendering on all such backgrounds shall have an undercoat of cement mortar with an admixture of waterproofing compound.

6.5.2.3 Where rendering is essential on backgrounds containing such salts and liable to become damp, the measures explained in Appendix A shall be taken. It is, however, to be emphasized that these measures will be useless unless care has also been taken to avoid risk of expansion of mortar joints in the background due to similar action.

6.5.3 *Types of Rendering* — The types of rendering and proportions of mix used are of the utmost importance from the point of view of durability as explained in **6.5.3.1** and **6.5.3.2.**

6.5.3.1 *Cement and cement-lime renderings* — Renderings consisting of Portland cement or Portland cement and lime, with a carefully selected and properly graded aggregate, have sufficient durability and do not require any protective coating. If a mix suited to the conditions and requirements is used and carefully applied as recommended in this standard, there will be no difficulty in obtaining a rendering of adequate durability for any situation.

6.5.3.2 *Lime-sand mix* — These mixes give renderings with fair strengths if properly used, but are subject to rapid deterioration if exposed to rain and frost. It is essential, therefore, for the durability of such external renderings liable to be exposed to rain, that a coating of paint or other protective material shall be applied. This coating shall be maintained in satisfactory condition; where the protective coating is allowed to fall into disrepair, the rendering may rapidly deteriorate. Simple lime-sand mixes are rarely used for external work except in dry areas with light rainfall, and their use is mainly confined to repair and alteration of old buildings and for such purposes hydraulic limes are generally used. Relevant details for application of lime plaster are given in *IS : 2394- Code of Practice for Application of Lime Plaster Finish.

6.5.4 *Method of Application, Particularly in Relation to the Nature of the Background* — Of the two general methods of application, namely, laying-on with a trowel or float and throwing-on either by hand or machine, throwing-on is likely to produce the more durable rendering due to better adhesion. This is especially so with a dense background having little suction, where satisfactory adhesion is difficult to obtain with the laying-on method.

6.5.5 *Atmospheric Conditions*

6.5.5.1 Accumulation of dirt or other deposited material will have the following effect upon renderings:

a) It may lead to failure of the rendering by introducing destructive substances, such as sulphur oxides, which attack the cementitous materials.

b) It will cause discoloration of the surface. This may not be harmful to the durability of the rendering, but may adversely affect the appearance, particularly when the discoloration is irregular.

6.5.5.2 Dirt will find a lodgement on the surface of even a dense and smooth finished rendering and, although rain may wash a certain

*Under preparation.

amount off, it will distribute the greater part, together with its own additional deposit, throughout the path of its flow. On surfaces of smooth finished renderings, this path is often restricted (*see* **6.4**) and tends to give an irregular, streaky or patchy discoloration. A rough textured surface, on the other hand, by breaking up the flow and spreading the rain water, and with it the dirt; will give a more uniform discoloration.

6.6 Resistance to Cracking — Cracking in renderings may result from the causes explained in **6.6.1** and **6.6.2.**

6.6.1 *Movements of the Structural Background* — Movements of the structural background upon which a rendering is applied may be of diverse forms and due to diverse causes, according to the nature of the background. Reference shall be made to the relevant Indian Standard dealing with the type of construction involved in any particular case.

6.6.2 *Movement of the Rendering* — Renderings, in common with other materials, undergo a slight change in volume as the moisture content changes and this results in shrinkage of the rendering upon drying out. As the background will usually be rigid, this shrinkage will set up stresses in the rendering, partly tensile and partly shearing along the plane of adhesion. The tensile stresses tend to cause cracking, and the shear stresses cause failure of adhesion between the rendering and the background; both may occur together. If the adhesion is sufficiently strong and uniform, the restraint so afforded may take up the whole of the shrinkage stresses; good adhesion, therefore, is an important factor in the avoidance of cracking.

6.6.3 Another factor affecting adhesion is the relative strength of the background and of the successive coats. In general, the first coat should be weaker than the background and each successive coat not stronger than that to which it is applied.

6.6.4 Creep, the internal relief of stresses, can help to avoid cracking by relieving shrinkage stresses. Its magnitude is small, it occurs naturally in all renderings, but no methods of encouraging it are known. An adequate time shall be allowed for each coat to dry out before the application of the next coat.

6.6.5 *Mixed Backgrounds* — Where a rendering is to be continuous across backgrounds of different classes, metal lathing or wire netting fixed across the junction will minimize cracking due to differential movements. Alternatively, it may be practicable to form a straight joint in the rendering along the line of the junction of the two backgrounds by cutting through each coat with a trowel or suitable sharp edged tool. The resulting gap should be sealed with a building mastic of suitable colour.

6.7 Resistance to Crazing

6.7.1 Crazing results from differential shrinkage of the surface of the rendering in relation to its interior. The cracks formed are narrow and generally do not extend far below the surface; they may, however, develop into shrinkage cracks. Dense, steel trowelled finishes are particularly liable to craze; on the other hand, a porous mix, with a scraped, textured, or other rough finish is highly resistant to this defect.

6.7.2 The risk of crazing may be minimized by:

a) the use of relatively weak mix for the finishing coat,

b) the avoidance of an excessive proportion of very fine material in the finish coat, and

c) the avoidance of excessive trowelling to prevent the drawing to the surface of an excess of laitance.

6.8 Thermal Properties — A rendered finish has little effect upon the overall thermal transmittance of a normal external wall, since the conductivity of the material is relatively high and only a thin layer of rendering is applied.

6.9 Sound Insulation (Air-Borne Sound) — The addition of a rendering to a wall (except one of very light-weight construction) will not significantly increase its resistance to the passage of sound.

6.10 Fire Resistance and Combustibility

6.10.1 An ordinary external rendering is non-combustible according to the definition in IS : 1641-1960 Code of Practice for Fire Safety of Buildings (General): General Principles and Fire Grading.

6.10.2 A rendering contributes to the fire resistance of a wall but no separate value for fire resistance of the rendering can be given; the data for fire resistance of walls with and without rendered finishes are given in IS : 1641-1960 Code of Practice for Fire Safety of Buildings (General): General Principles and Fire Grading.

6.11 Recommended Mix Proportions — Mixes suitable for different types of rendering are given in Table III. Where alternative mixes are given, selection shall be made on the following considerations:

a) The mix for each such successive coat shall never be of a type richer in cement than the mix used for the coat to which it is applied.

b) The type richer in Portland cement shall be preferred when it is applied under winter conditions.

TABLE III RECOMMENDED MIXES FOR EXTERNAL RENDERINGS IN RELATION TO BACKGROUND MATERIAL, EXPOSURE CONDITIONS AND FINISH DESIRED

(*Clause* 6.11)

MIX: Type 1 to 5 shall consist of Portland Cement : Lime : Sand (by volume);
Type 6 shall consist of Portland Cement : Coarse Aggregate of size 6 to 12 mm (by volume). The proportions are:

Type 1 — 1 : 0 : 4
Type 2 — 1 : 0 : 5 to 6
Type 3 — 1 : 1 : 6 to 7
Type 4 — 1 : 2 : 9 to 10
Type 5 — 1 : 0 : 3
Type 6 — 1 : 3

BACKGROUND MATERIAL	TYPE OF FINISH	TYPE OF MIX RECOMMENDED FOR THE GIVEN EXPOSURE CONDITIONS					
		First and subsequent Undercoats			Final Coat		
		Severe	Moderate	Light	Severe	Moderate	Light
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dense and strong	Wood-float	1	2	2 or 3	1	2	2, 3 or 4
	Scraped or textured	2	3	2 or 3	2	3	2 or 3
Moderately strong and porous	*Roughcast*	5	5	5	6	6	6
	Dry-dash	5	5	5	—	—	—
Moderately weak and porous	Wood-float / *Scraped or textured*	2	3	4	Same as for undercoats		
No-fines concrete	Wood-float	1	2	2 or 3	1	2	3 or 4
	Scraped or textured	1	2	2 or 3	1	2	3 or 4
	Roughcast	5	5	5	6	6	6
	Dry-dash	5	5	5	—	—	—

(*Continued*)

TABLE III RECOMMENDED MIXES FOR EXTERNAL RENDERINGS IN RELATION TO BACKGROUND MATERIAL, EXPOSURE CONDITIONS AND FINISH DESIRED — *Contd*

Background Material	Type of Finish	Type of Mix Recommended for the Given Exposure Conditions					
		First and Subsequent Undercoats			Final Coat		
		Severe	Moderate	Light	Severe	Moderate	Light
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Metal lathing or expanded metal	Wood-float	1	1	1	2	2	2
	Scraped or textured						
	Roughcast	5	5	5	6	6	6
	Dry-dash	5	5	5	—	—	—

NOTES 1 — For special mixes for high sulphate backgrounds, *see* Appendix A.

2 — For repair work, *see* **11.**

3 — For preparation of background, *see* IS : 1661-1960 Code of Practice for Cement and Cement-Lime Plaster Finishes on Walls and Ceilings.

4 — Where alternative sand contents are shown for the cement : lime : sand mixes (for example 6 to 7 parts in mix Type 3) the higher of the sand contents (that is 7 parts) should be used if the sand is coarse or well graded, but the lower sand contents (that is 6 parts) should be used if the sand is fine.

5 — The types of finish that are shown in italics in the table are those to be preferred in most circumstances.

6 — Mixes for machine-applied decorative finishes are generally supplied as ready-mixed proprietary materials and should be used in accordance with the manufacturer's instructions. For some types, the whole process is proprietary. For dense cement-gun finishes, mixes of cement and sand only are used.

7 — In the case of coloured cement renderings, the undercoats must be admixed with a suitable waterproofing compound. The preparation of admixture should be according to the instructions of the manufacturers.

6.12 Number of Coats — Normally one coat is sufficient for ordinary buildings in dry or moderately wet climates. For important buildings or for buildings in areas of heavy rainfall and for uneven backgrounds, two coats will be required. For pebble-dash and roughcast at least one undercoat will be necessary.

6.13 Functions of Different Coats and Their Recommended Thicknesses

6.13.1 *Undercoats* — Undercoats serve various purposes. They provide a means of straightening or levelling an uneven surface; they seal the surface of the wall, and are often the most important part of the treatment in preventing rain penetration; they provide a surface of even suction and satisfactory adhesion for the finishing coat, and they prevent 'grinning' of joints or of areas of differing suction through the finishing coat. An undercoat in any part shall have a thickness of not less than 8 mm, nor more than 12 mm. If greater thickness is required to build up an even surface, additional undercoats shall be used as required. For coloured cement renderings, the undercoat must be admixed with waterproofing compound to provide a waterproofing base.

6.13.2 *Final or Finishing Coat* — The thickness of the final or finishing coat will be governed to some extent by the texture required, but will normally be 3 to 8 mm as finished. Some of the fine-textured machine-applied finishes may be as thin as 3 mm.

6.13.3 *Single Coat Rendering* — In the case of dense background, such as of cement concrete, or where surface of the background is very even (as for example, walls built with hollow concrete blocks) or buildings subjected to moderate or light exposure conditions, wood-float rendering can be applied in one coat. It shall not exceed 18 mm or be less than 6 mm in thickness in any part. But extreme care shall be taken in preparing the surface of the background as explained in **8.1.1** to ensure adequate bond between the rendering and the background.

6.14 Colour

6.14.1 Only the finishing coat need be coloured and this can be done by the following methods:

a) *Using a suitable sand or other aggregate* — If delicate coloured effects are desired, the aggregate shall be most carefully selected to give the required effect in the finished rendering; a consistent supply shall be assured.

b) *Using white or coloured cement or by the addition of suitable pigments to the mix* — To ensure a uniformity of colour, it is generally advantageous to use a coloured cement, rather than to mix in the pigments as required on the site.

6.14.2 When light colours are required, it is preferable to use a white cement; other cements have a deadening effect upon most colours. Lime added to a coloured cement mix will lighten the colour.

6.14.3 Proprietary finishing materials, which require only mixing with water, are obtainable in white and a variety of colours. Such proprietary mixes have advantages in the control and uniformity of colour and texture obtainable.

6.14.4 Coloured finishes, particularly of the deeper colours, are liable to suffer lightening of the colour through formation of a white film of calcium carbonate on the surface, known as 'lime bloom' or efflorescence. The incidence of this depends to some extent upon the grading of the sand, but mainly on the conditions of finishing the surface and the subsequent drying conditions. No definite recommendation can be made for avoiding it.

6.14.5 The effect of atmospheric pollution and discoloration by sooty deposits should be taken into account in choice of colour (*see also* **6.5.5**).

7. PRELIMINARY WORK

7.1 Scaffolding — Where possible, independent scaffolding shall be used, to obviate the subsequent restoration of masonry in putlog holes and other breaks in the work. Scaffolding shall be checked to make sure that it is suitable and safe.

7.2 Cleanliness and Protection of Adjacent Work

7.2.1 All existing work and fittings that are likely to be damaged in the application of renderings shall be protected.

7.2.2 Cleanliness is essential in all stages of the work. Gauge-boxes, tools and anything else used in the preparation or application of the mixes shall be kept clean. The platform of mix container shall be cleaned immediately after each batch of mixed material has been used up.

7.2.3 Care shall be taken to avoid, as far as possible, the splashing of mortar on to finished surfaces, such as brickwork, joinery, paintwork and glass; any such splashes shall be cleaned off immediately.

7.2.4 On completion, any mortar splashings, formerly missed, shall be carefully removed so as to avoid, where possible, damaging the surfaces from which they are removed, and the whole of the work including the rendering itself and other surfaces shall be left clean.

7.3 Preparation of Mortar Mix

7.3.1 *Proportioning*

7.3.1.1 The material used in the preparation of plastering mixes may be measured either by volume using gauge-boxes or by weight. Measurement by weight of the dry materials is the more accurate method of proportioning and shall preferably be used.

7.3.1.2 Variations in mix proportions may occur if proportioning is done by volume. Adjustment for such variations may be made as explained in the relevant Indian Standard on preparation of masonry mortars.

7.3.1.3 Cement shall be measured by weight, 1 440 kg of the material being taken as equivalent to one cubic metre for the purpose of proportioning.

7.3.1.4 Proportioning of lime may be done by measurement of volume as lime putty, or by measurement of weight of quicklime or dry hydrated lime before the preparation of putty. The mix proportion of lime, unless otherwise stated, generally refers to the volume of putty, and when measurement is done on quicklime or dry hydrated lime, their quantities shall be such as to yield the required volume of lime putty.

7.3.1.5 *Quantity of water* — For general cement plaster work with 1 : 3 proportion, the quantity of water required is about 70 percent by weight of cement. This may, however, vary depending on the following factors, and adjustment shall be done as explained in the relevant Indian Standard on preparation of masonry mortars:

a) The nature and condition of the fine aggregate;

b) The temperature and humidity at the time of working;

c) Richness of the mix, namely, whether richer or leaner than 1 : 3;

d) The varying quantities of lime in composite mortar; and

e) The use of admixtures added for improving the workability.

7.3.2 *Mixing*

7.3.2.1 *Cement-lime plaster* — The cement-lime plaster shall be prepared by any one of the methods given in (a) and (b):

a) Lime putty and sand shall be mixed in the required proportions and kept protected from drying out till the time of use. The required quantity of cement shall then be added and the whole mass thoroughly mixed. Water shall be added if necessary, but only to the minimum extent required to give a working consistency for the plaster.

b) If the sand used is fine sand, cement and sand in the required proportions shall be mixed dry in a mixer. Lime putty thinned with water shall then be added to the mixer and the contents mixed for some time until a satisfactory mortar is obtained. The quantity of water added to lime putty shall be slightly less than the finally required quantity to ensure that no lime water will be left over in the mixer. Final adjustment of water to obtain a mortar of required consistency may be made by adding clean water afterwards.

If the sand used is coarse sand, lime putty and sand in the required proportions shall first be mixed on a clean water-tight platform. Necessary quantity of water shall then be added and the mixture mixed again. The mixture shall be ground in a masonry lined mortar-mill. Grinding shall be done for at least 120 revolutions, and the mortar shall be raked up continuously during the process, particularly at corners. Water may be added as required during the grinding. The mix shall then be transferred to a mechanical mixer to which the required quantity of cement is added, and the contents mixed for some time until a satisfactory mortar is obtained.

7.3.2.2 *Cement plaster* — Cement and sand shall be mixed dry in the required proportions to obtain a uniform colour. Water shall then be added to get the required consistency for the plaster.

7.3.2.3 Cement-lime plaster or cement plaster shall be used within half an hour after the addition of water to cement. Any mortar for plaster which is partially set, shall be rejected and removed forthwith from the site.

7.3.2.4 Mixing may be done either manually or mechanically. 'Hand Mixing' shall be carried out on a clean, water-tight platform; during mixing, the mortar shall be hoed back and forth with addition of necessary quantity of water until a mixture of uniform appearance and consistency is obtained. In 'Machine Mixing' the mixer shall run at least five minutes after placing all the ingredients in the drum.

Machine mixing is preferable to hand mixing for cement mortars, and since all mixed materials have to be used up within half an hour, it is important that the batch is not too large.

7.4 Preparation of Background

7.4.1 To obtain satisfactory bond between background and the base coat and to ensure that this bond is maintained subsequently, the background shall be prepared to fulfil the requirements explained in **7.4.1.1** to **7.4.1.7**.

7.4.1.1 *Cleanliness* — The loose layer of dust on masonry shall be brushed with a stiff bristle or wire brush; brushing may advantageously be combined with blowing of compressed air. The laitance, if any, found on the freshly cut concrete surface shall also be removed. The concrete surface if found contaminated with soap which is formed by reaction of resins with calcium hydrate or is derived from mould oils, shall also be removed with a brush. If the background contains soluble salts, particularly sulphates, the application of plaster shall be done only after the efflorescence of the salts is complete and is thoroughly removed from the surface. Any trace of algae or moss formation shall also be removed.

7.4.1.2 *Roughness* — The roughness of the background may generally improve the bond between the surface and the rendering. A smooth surface shall be roughened by wire brushing or by hacking or bush-hammering. After roughening the surface, care shall be taken to moisten the surface sufficiently before the base coat is applied as otherwise the freshly exposed surface may tend to absorb considerable amount of water from the plaster. The joints in the masonry shall also be raked to a depth of about 1 cm for providing key to the plaster. Special backgrounds, such as expanded metal lathing, wire netting, etc, may be fixed if required to improve further the key to the plaster.

7.4.1.3 *Suitable suction* — Adequate time shall be allowed between the erection and application of rendering finish to make the surface suitable for suction adjustment. Careful adjustment of suction is necessary for proper adhesion of base coat to the surface and may be done by wetting the backing suitably if it is dry, or by sprinkling with a cement mix as in the case of concrete surface with low suction. Without the aid of suction, plaster would creep and slide down due to its own weight. On the other hand, very strong suction withdraws all moisture from plaster and makes it weak, porous and friable. Too much water makes it impossible to keep the mortar in position till it sets.

The background shall not be soaked but only damped evenly before applying the rendering. If the surface becomes dry in spots, such areas shall be moistened again to restore uniform suction. A fog spray is recommended for this work.

7.4.1.4 *Evenness* — Any unevenness shall be levelled before the rendering is applied. For finishes applied in three-coats local projections shall not exceed 1·2 cm proud of the general surface as determined by the periphery of the surface concerned and local depressions shall not exceed 2·0 cm. For two-coat work the local projections shall not exceed 0·6 cm and local depression shall not exceed 1·2 cm.

7.4.1.5 *Strength and elasticity* — The strength and elasticity of plaster shall be compatible with that of the background.

7.4.1.6 *Immobility* — The differential movements between the background and the plaster due to moisture changes, temperature changes, structural settlement, deflection, etc, cause cracks in the rendered finish. The major part of such movements shall be allowed to set in before the rendering is applied. In the case of moisture movements, sufficient drying interval for the background shall be allowed. The background must be immobile at the time of application of the plaster, or subsequently the movements of the background are such as to be in step with and in the same direction as that of the rendered finish.

7.4.1.7 *Precautions against discontinuity in backgrounds* — Precautions similar to those described in **6.6.5** shall be taken.

7.4.2 The preparation for different types of backgrounds shall be done as specified in **7.4.2.1** and **7.4.2.2.**

7.4.2.1 *Brickwork or hollow block masonry* — The joints of new work, particularly if the bricks or blocks are smooth, shall be raked out as the work proceeds. Projecting bricks shall be trimmed off where necessary. The masonry shall also be allowed to dry sufficiently so that the initial drying shrinkage is fairly complete and suction adjustment is possible during application of rendering. In the case of old brickwork, surface shall be thoroughly brushed down to remove dust, loose particles and efflorescence, if any. Low spots, where necessary, shall be filled in by means of a mix similar to that intended for the base coat but richer and coarser, and ample time shall be allowed for the filling material to dry out before the base coat is applied.

7.4.2.2 *In-situ concrete* — The concrete surface shall be sufficiently rough to provide adhesion and shall be evenly wetted (not saturated) to provide correct suction. The surface shall be cleaned of all dust, loose particles, laitance, efflorescence and all other such matter. Laitance and efflorescence shall preferably be removed by dry methods. Grease and oil shall be removed as completely as possible. The surface shall be made sufficiently rough by hacking and bush hammering. If this is not possible, key shall be provided by an initial coating of mortar composed of one part of cement to $1\frac{1}{2}$ to 3 parts of coarse sand, mixed to a wet consistency. The mix shall be forcibly dashed on to the concrete surface by suitable means and allowed to harden before application of the last coat.

If a chemical retarder has been applied to the formwork, care shall be taken that none of the retarders is left on the concrete or other surfaces. A roughened surface may then be formed by wire brushing and all the resulting dust and loose particles cleaned off. Where mechanical key forming devices have been used in the concrete, these shall be stripped off if still adhering and the resulting surface cleaned down. Ridges or fins left by shuttering imperfections shall be removed before cleaning down, to be compatible with the finish to be applied.

7.5 Fixing Metal Lathing or Expanded Metal as a Background

7.5.1 The metal lathing or expanded metal shall be of 6 mm to 10 mm mesh and shall be applied with the long way of the mesh across the supports. If the supports are more than 35 cm apart, the gauge of the metal shall be increased above that normally used, according to experience, to give sufficient stiffness. As most of metal lathings are proprietary types, detailed recommendations cannot be given and the manufacturer's advice should be obtained regarding their erection.

7.5.2 The strands in the various sheets shall all slope in one direction; in vertical work they should slope inwards and downwards from the face of the rendering.

7.5.3 In order to space the lathing from the face of the bearers and thereby ensure continuity of the key at these points, small round rods, V-shaped ribs or strips of hardwood may be fixed on the face of the supports.

7.5.4 For fire protection of steel columns the metal lathing is normally spaced from the columns by a spiral of 3 mm steel wire of 30-cm pitch, wrapped round the columns before the metal lathing is fixed, or by cradles or stirrups of 6 to 10 mm diameter mild steel rod. This is done primarily to give increased rigidity to the lathing, but it also assists in key formation on the flanges.

7.5.5 All sheets shall be lapped not less than 2·5 cm at the sides and ends; overlaps shall not occur at angles or curves and end laps shall occur only at supports.

7.5.6 Sides of sheets shall be wired together with galvanized wire of diameter not less than 1·25 mm, every 10 cm between supports.

7.5.7 Cut ends of wire used for fastening shall be bent inwards and not towards the finishing coat.

7.5.8 Expanded metal, when applied to timber supports, shall be secured by means of galvanized nails or staples driven skew-wise across the grain of the timber at intervals of not more than 10 cm. If nails are used, they shall be of the flat-headed type. Expanded metal, when applied to steelwork, shall be secured by wire or clips.

7.5.9 After erection, all cut edges and damaged staples or nail heads shall be given a protective coat of bitumen-oil paint.

8. APPLICATION OF RENDERING COATS

8.1 General

8.1.1 Just before applying the first coat the surface of the background shall be roughened, if necessary, thoroughly cleaned of loose particles and

dust and sufficiently moistened to prevent absorption of moisture from the rendering mortar in order to ensure adequate bond with the background. A newly cement rendered surface shall be prevented from drying out too rapidly by spraying the surface with water and keeping it continuously moist for at least four days. In sunny weather, the work shall be carried out in the shade, whenever possible, following the sun round as the day passes.

When using mixes containing high alumina cement, the work shall not be done in very hot weather and it shall be kept thoroughly damp for 48 hours after application by protecting from the sun and wind or by spraying.

8.1.2 Between two coats, it is desirable to have an interval of at least 24 hours in hot and dry weather and more in cold and wet weather.

8.1.3 When rendering on metal lathing or expanded metal, back rendering, whenever it can be applied, shall be done when the first undercoat on the face is hard enough to permit this. The work shall then be allowed to dry as completely as possible before applying further coats. Neglect of this precaution may be a frequent cause of cracking.

8.1.4 With certain textured finishes and the dry-dash finish, it is essential for the final coat to remain plastic for a longer time than normal. This may be assisted by reducing the suction of the undercoat by more thorough wetting down. If the undercoat is a cement-sand mix, it may also be helpful to use a water-repellent admixture in the undercoat mix.

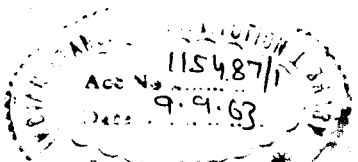
8.1.5 The finishing coats shall be applied from top to bottom (except for English cottage finish, where the procedure should be reversed) and, in doing so, care shall be taken to avoid joints in continuous surfaces.

8.2 First Undercoat

8.2.1 This may be applied either by laying on with or throwing from the trowel.

8.2.2 The undercoat shall be applied as uniformly as possible but not less than 8 mm nor more than 12 mm thick in any part. It shall be left rough and open from the edge of the laying trowel and, after it has been left long enough to set firm, the surface shall be combed or scratched, care being taken to leave the scratch marks sufficiently deep to provide a key for the following coat, but not so deep as to penetrate the rendering.

8.3 Subsequent Undercoat — Where an additional undercoat becomes necessary, the first undercoat shall be brushed down to remove



any dust and loose particles and shall be slightly wetted. This coat shall not exceed 12 mm in thickness; the surface, when firm, shall be combed or scratched.

8.4 Plain Finishing Coats — The finishing coat shall be not less than 3 mm or more than 8 mm thick and shall be applied with a laying trowel and finished with a wood, felt, cork, or other suitably faced float. A steel trowel shall not be used and overworking shall be avoided. Water shall not be applied to the surface of the finishing coat whilst working up, but patches showing signs of premature drying may be patted with a damp float.

8.5 Scraped or Textured Finishing Coats — Various scraped or textured finishes can be obtained by hand or machine application and by different tools and methods. Successful effects depend upon the artistry as well as the skill of the craftsman. The thickness of the final coat is governed to some extent by the texture required. For scraped finishes, the final coat is usually applied to a thickness of about 6 to 12 mm of which about 3 mm is removed in the scraping process. Scraping shall be done after setting has taken place, but before the mortar has become too hard. The precise time will depend upon the mix and the atmospheric conditions. The surface skin of the mortar shall be removed to expose the aggregate. The texture obtained depends mainly on the grading of the aggregate.

8.6 Roughcast Finish — The final coat, the mix for which shall be quite wet and plastic, is thrown on by means of a trowel or scoop.

8.7 Dry-dash Finish

8.7.1 For dry-dash finish, the undercoat shall be laid on to a thickness of about 8 mm and shall be lightly pressed over to straighten it. The aggregate used for dashing shall be well washed and drained and thrown wet on to this coat while it is still plastic.

8.7.2 To ensure satisfactory bond between the dashing and the mortar, the aggregate may be lightly tapped into the mortar with a wood float or the flat of a trowel.

8.8 Machine-Applied Finishes — All adjacent surfaces which might be stained or damaged shall first be masked. The precise method of application will depend on the particular machine used. Generally, it is necessary to allow the undercoat to harden and dry out sufficiently to provide adequate suction, the finish is then applied at such a rate as to ensure the desired texture.

8.9 Architectural Features — Any architectural features, such as quoins, mouldings and sills, shall be marked out and built up to the required shape and thickness, or cast and planted, before the finishing coat

is applied. When forming heavy cornices, great care shall be taken in coring; it is preferable to build up with small quantities of material well keyed before each subsequent addition, rather than to apply too much material at one time.

9. CURING

9.1 Curing of rendered finishes is necessary to develop their maximum strength and density. Each coat shall be kept damp continuously for at least two days. Moistening shall commence as soon as the plaster has hardened sufficiently and is not susceptible to injury. The water shall be applied by using a fine fog-spray. Soaking of wall shall be avoided and only as much water as can be readily absorbed shall be used. Excessive evaporation on the sunny or windward sides of buildings in hot dry weather shall be prevented by hanging mattings or gunny bags on the outside of the plastered surface and keeping them wet.

9.2 After the completion of the final finishing treatment, the surface shall be kept wet for at least seven days during which period it shall be protected from exposure to extremes of temperature and weather.

10. MAINTENANCE

10.1 Cleaning

10.1.1 Rendered finishes may be cleaned by washing down with water applied through a fine jet at pressure.

10.1.2 Organic growths of fungi, algae, etc, shall be killed by treatment with a suitable fungicide and the dead dry material brushed off after a suitable interval. Reference may be made to *IS : 2395- Code of Practice for Painting Calcareous Surfaces, for application of suitable fungicide.

10.1.3 All cracks and damaged areas shall be repaired (*see* **10.2** *and* **11.1**).

10.2 Repairs to Cracks

10.2.1 *General* — Inconspicuous cracks in walls that remain dry and sound are usually best left alone. Cutting and repairing, however carefully done, invariably results in some differences in appearance over the area of the repair.

10.2.2 *Cracks Occurring in Rendered Finishes Only* — Cracks which form in rendered finishes and do not penetrate into the background can

*Under preparation.

usually be attributed to failure of adhesion adjacent to the crack. In order to carry out satisfactory repairs, the area surrounding the crack shall be tested for hollowness by tapping the surface and the hollow areas shall be cut out. If hollowness is not detected, the material on both sides of the crack shall be cut out to a total width of not less than 7·5 cm. Any material that develops hollowness or loses its adhesion during cutting-out shall also be removed. The edges of the cut material shall be either left square or, preferably undercut and the background well brushed and washed to remove any dust or loose material.

10.2.2.1 Where only very fine cracks are present and the work appears to be otherwise sound, coating the whole of the rendered finish with a cement paint or other decorative treatment may be adequate to close and conceal the cracks.

10.2.3 *Cracks Occurring in Rendering and Base* — Where cracks penetrate not only the rendering but also the background, the cause of the cracking shall be ascertained and dealt with before proceeding with the repair. The background shall first be restored. Where it is not possible to effect complete repair of the background, the rendering shall be cut back on both sides of the cracks for at least 15 cm and light expanded-metal shall be fixed to the background and embedded in the undercoat of the rendering. This method may not entirely prevent further cracking but it will reduce its severity. Cracks occurring at the junction of dissimilar materials, that is, on mixed backgrounds, may alternatively be dealt with as described in **6.6.5**.

10.2.4 *Restoring Rendering* — The area cut out in repairing cracks should be made good according to the nature of the background and the type of finish, as described for new work in this code. Since it is unlikely that the areas made good will exactly match existing work, consideration shall be given to the possibility of coating the whole of the repaired work with a cement paint or other decorative finish.

11. REPAIR OF DAMAGED AREAS

11.1 General — The need for repairs to external rendered finishes may arise from neglect, damage, use of unsuitable materials or treatments, or unsatisfactory design of the building. The procedures for repairs arising out of various causes are dealt with in **11.2** to **11.3**.

11.2 Loss of Adhesion

11.2.1 Loss of adhesion may arise from various causes. Defective design or detailing may allow water to penetrate and this can lead to

expansion of the background or of the rendering as a result of either frost or sulphate action. Loss of adhesion may also arise from incorrect composition of the rendering in relation to the background or due to excessive absorption of moisture from the undercoat mortar if the background has not been properly moistened prior to applying undercoat.

11.2.2 Where water penetration is an obvious or suspected cause of failure, this shall first be remedied. Prevention of the ingress of water shall be effective against frost action and is generally the only practicable step that can be taken against further sulphate action.

11.2.3 When the causes of failure have been dealt with, the patches of damaged rendering shall be cut out cleanly, preferably to rectangular areas, down to the background. The exposed edges of the existing rendering shall be cut square or preferably undercut. The exposed surface of the background shall be well brushed to remove dirt or loose material and washed, and the prepared surface treated with a coat of cement grout comprising one part of cement and one part of fine sand. The area cut out shall be made good according to the nature of the background and the type of finish as described for new work in **8**. The colour and texture of the new rendering shall be matched as closely as possible to the existing work; for this purpose the sand for the mix should be carefully selected and pigments or coloured Portland cement may be incorporated as required. It is desirable to prepare small test panels before finally deciding upon the mix to be used.

11.3 Mechanical Damage — In repairing mechanical damage, the principles of repair as described in **10.2** shall be followed.

11.4 Overcoming Unsatisfactory Appearance

11.4.1 It may be desired to change the appearance of a rendering because of unsatisfactory quality, discoloration or deposition of dirt or for aesthetic reasons. Necessary improvement or change may be effected by cleaning as described in **10.1**, by renewing the existing rendering or by giving suitable paint treatment.

11.4.2 *Paint Treatment* — External rendering may be painted satisfactorily with various types of paints, such as cement paints, emulsion paints, bituminous emulsion paints and oil paints of appropriate types. Reference shall be made to *IS : 2395- Code of Practice for Painting Calcareous Surfaces, for the selection and application of suitable paints.

*Under preparation.

11.5 Overcoming Damp Penetration

11.5.1 *General* — The causes of damp penetration through renderings are discussed in **6.4**. Where such penetration is due to the presence of cracks, they shall be dealt with as indicated in **10.2**. Where damp penetration results from rain-runs due to defective design features, these should, if possible, be remedied. Where penetration cannot be assigned to either of the above causes, one of the treatments specified in **11.5.2** and **11.5.3** shall be applied.

11.5.2 *Colourless Treatments* — The surface of the rendering can be made water-repellent by treatment with appropriate colourless solutions sold for this purpose. These consist either of solutions of silicones or of waxes and the like. Those based on silicones may produce a more lasting effect. These materials are proprietary types and shall be applied in accordance with the manufacturers' instructions. All types need renewal after a period of some years.

11.5.3 *Paint Treatments* — Paint treatments, regularly applied, will effectively prevent rain penetration through renderings. They shall be applied as described in *IS : 2395- Code of Practice for Painting Calcareous Surfaces.

APPENDIX A

(*Clause* 6.5.2.3 *and Table* III)

MEASURES TO OVERCOME THE EFFECTS OF SOLUBLE SULPHATES FROM BACKGROUNDS ON RENDERINGS

A-1. One of the measures specified in **A-2** and **A-3** may be taken to overcome the effects of soluble sulphates from backgrounds on renderings.

A-2. A separate support may be provided for the rendering. This may be done by battening out and applying metal lathing or other subsidiary background.

A-3. A cement resistant to sulphate action may be used, namely, sulphate-resisting Portland cement or, in very severe conditions, high alumina cement or blastfurnace slag cement.

*Under preparation.

A-3.1 The sulphate-resisting Portland cement may be used exactly as ordinary Portland cement in the various mixes indicated in **6.11** and Table III. Where alternatives are given, the mix richer in cement shall be used.

A-3.2 High alumina cement shall not be mixed with lime. It shall be used in the following mixes:

In place of Type 1 mixes (*see* Table III)	1 part high alumina cement : 3 parts sand by volume
In place of Type 2 mixes (*see* Table III)	1 part high alumina cement : $\frac{1}{2}$ to $\frac{3}{4}$ part zinc sulphate powder : 4 parts sand, all by volume
In place of Type 3 or Type 4 mixes (*see* Table III)	1 part high alumina cement : 1 part zinc sulphate powder : 5 to 6 parts sand, all by volume

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