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Code of practice

External rendered finishes

(formerly CP 221)

Conduits extérieurs de finitions

Endbearbeitung mit Aussenputz

British Standards Institution

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

Foreword

This code, first published in 1960, has been revised to bring the recommendations into line with current techniques. The 1960 code is now withdrawn.

The term 'external rendered finishes' used in this code is restricted to methods of applying external rendering based on hydraulic cement. A rendered finish may be applied to many types of background, either for aesthetic reasons or

to improve resistance to rain penetration and weathering.

The recommendations are framed in logical sequence: the influence of the background on the choice of render mixes; guidance on preparation of surfaces to be rendered; choice of suitable mixes and methods of application.

Data on the choice of mixes for different backgrounds and finishes are given in tabular form.

Code of practice

External rendered finishes

(formerly CP 221)

Section one. General

1. Scope

This code deals with external renderings on all common types of backgrounds. It includes renderings on both new and old backgrounds and the maintenance and repair of existing work. Renderings for liquid retaining structures such as tanks and manholes and renderings applied as a background for any form of cladding are not included.

2. References

The titles of the British Standards and codes of practice referred to in this code are listed on the inside back cover.

3. Definitions

For the purposes of this code, the definitions given in BS 4049 apply.

4. Exchange of information

The working drawings and specifications should be prepared in sufficient detail to afford proper guidance in the preparation of estimates and the execution of the work. Where bills of quantities form part of the contract, they should be prepared in accordance with the Standard Method of Measurement of Building Works or the Code for the Measurement of Building Works in Small Dwellings as appropriate. There should be an exchange of information between those responsible for the constructional work, the rendering and any subsequent work, and with other trades whose work will affect or be affected by the rendering, as soon as possible after acceptance of contract.

As soon as the contract for the rendering has been allocated, the contractor should be furnished with all necessary working drawings and should visit the site to acquaint himself with building progress. He will then be in a position to arrange for any necessary preparatory work to be carried out without causing delay to work that is to follow.

The date when each area is rendered should be recorded. Records should also include critical dates concerning the building construction and the preparation of backgrounds for rendering.

5. Time schedule

The time schedule planned for any building work should include external rendering, if applicable. Where possible, this schedule should be agreed in consultation with those who will become responsible for carrying out the work.

In preparing the time schedule, each operation should be considered in relation to the others, and due consideration given to the economical use of construction plant, equipment and scaffolding by all trades. Consideration should also be given in the schedule to ensuring that the various trades follow one another in a correct sequence and do not interfere unduly with each others' work. Scaffolding should be sound and in accordance with the requirements of CP 97 and the Construction Regulations made under the Factories' Acts. Scaffolding should be tested or thoroughly examined before erection and the completed scaffold examined both before use and weekly by the foreman responsible for the men working upon it.

The schedule should allot times for the construction and preparation of the backgrounds to receive renderings and allow sufficient intervals for drying out and shrinkage of the background to take place. The schedules should include times for commencement of rendering and allow for sufficient time between coats for drying out and shrinkage to take place. Due regard should also be given to any special requirements for finishing coats which are usually applied downwards starting from the top.

In addition, the contractor responsible for the rendering should maintain a detailed programme for his work prepared in consultation with those responsible for the general building contract.

Arrangements should be made and time allowed for regular site inspections to enable any defects to be located and remedied, and for drying out and maturing of such repairs at the correct stages as the work proceeds.

The time schedule should be carefully planned to avoid risk of serious damage or difficulties occasioned to or by other trades.

Section two. Materials

6. Cements

Cement should comply with the requirements of one of the following British Standards:

BS 12; BS 146; BS 915; BS 4027; BS 5224.

7. Limes

Building limes should comply with the requirements of BS 890.

8. Aggregates

8.1 Sands. Sands should preferably comply with the requirements of BS 1199. The working properties of mixes, their water demand and the behaviour of the finished rendering may all be affected by the choice of sand. The importance of using a properly graded sand cannot therefore be over-emphasized. Experience has shown that many sands which do not comply strictly with the requirements of BS 1199 can give satisfactory results. It is recommended that enquiries be made regarding locally available sands and their use. For undercoats, the coarsest and sharpest sand which can be conveniently handled should be employed. The most suitable grading of sand for the final coat will depend, to some extent, upon the finishing treatment. The same grading used in the undercoats will be suitable for some finishing coats such as floated, scraped and dry dashed. For some textured finishes however, such as those produced by treatment of the freshly applied final coat with a tool, it may be desirable to remove the coarser particles (e.g. by screening) while for others, such as 'torn' textures, a slightly larger proportion of material coarser than the 5 mm size may be needed.

Sands derived from certain sources, notably some areas in southern Scotland and the north of England, are themselves prone to shrinkage and their use can result in higher shrinkage movements of the rendering than might be experienced with other sands.

8.2 Coarse aggregate. Natural aggregate other than sand should comply with the requirements of appropriate clauses of BS 882. For rough-cast (wet-dash or harling), crushed stone or fine gravel up to 13 mm maximum size 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 5 mm) to fine should be between 1:1 and 1:2 by volume.

For dry-dash finishes, pea shingle, spar, crushed hard limestone, marble chippings or other crushed stone of required appearance and satisfactory durability in a 5 mm to 10 mm or 7 mm to 13 mm grading should be used.

8.3 Artificial aggregates. Artificial aggregates manufactured or derived from industrial by-products may be used but care should be taken to ascertain that they have adequate durability and have no adverse effect upon the rendering or the background. They should comply with the requirements of British Standards where applicable.

9. Pigments

Pigments included in BS 1014 should comply with the requirements of that standard which, however, does not cover a full range of colours. Other pigments should be used only if they are known to be satisfactory. The essential requirements are that the pigments are stable, are unaffected by lime or exposure to light, are not easily leached out by water and that they have no adverse effect upon the cement or other constituents of the rendering.

10. Fibres

For normal rendering work fibres are now used only rarely. However in some specialized spray applications fibres, particularly of synthetic materials, are likely to be used.

10.1 Natural hair. Goat hair is occasionally used. It should be long, clean, free from grease and dry.

10.2 Vegetable fibres. Flax, sisal, manilla, jute, hemp, ramie or coconut fibres are all suitable, though they cannot be regarded as equally satisfactory to natural hair for incorporation on the site. The fibres should be long, clean, free from oil and dry.

10.3 Synthetic fibres. Alkali-resistant glass-fibre, polypropylene and rayon are available but their use is normally, though not necessarily, confined to sprayed render mixes.

11. Admixtures

11.1 Workability aids. Organic workability aids (plasticizers) should comply with the requirements of BS 4887 and should be used in accordance with the manufacturers' instructions.

11.2 Waterproofers. Integral waterproofers are available as proprietary materials and should be used in accordance with the manufacturers' instructions.

11.3 Water retaining agents. Water retaining agents are normally cellulose derivatives and should be used in accordance with the manufacturers' instructions.

12. Bonding agents

Organic bonding agents for aiding the adhesion of rendering materials to smooth surfaces are available as proprietary materials.

The use of polymers based on polyvinyl acetate should be restricted to spatterdash coats prepared in accordance with the manufacturers' instructions (see 20.1.2(b)).

Polymers based on styrene-butadiene rubber and acrylic resin are available as proprietary materials. No recommendations for their use are given in this code because sufficient long-term experience is not yet available.

13. Water

Water fit for drinking is normally suitable for mixes for rendering. Attention is drawn to the requirements of BS 3148 in cases where water supplies may be of doubtful quality.

14. Ready-mixed rendering materials

14.1 Ready-mixed lime:sand. Ready-mixed lime:sand for mortars should comply with the requirements of BS 4721 and should be mixed with cement on site. Ready-mixed lime:sand may be supplied with pigments (complying with clause 9) and/or fibres (complying with clause 10) and/or admixtures (complying with clause 11) incorporated by agreement between supplier and contractor where their use is specified.

Recommendations for proportions for mixes most commonly encountered are given in table 1.

14.2 Bagged rendering materials. Various ready-mixed dry materials supplied in bags are available. Their ingredients should comply with the appropriate recommendations made within this section of the code. Mix proportions and mixing instructions should be clearly stated on the bags.

15. Metal lathing and reinforcement

All metal lathing and reinforcement of whatever type, including that used for permanent formwork, should be galvanized or be of stainless steel.

15.1 Expanded metal. Expanded metal is described in BS 405 and BS 1369; it should be manufactured from tight coated galvanized sheet made in accordance with the requirements of BS 2989, class 1C. It should weigh not less than 1.90 kg/m^2 and have a minimum aperture of 6 mm measured the short way of the mesh.

15.2 Ribbed lathing. This material is described in BS 1369. Ribs are formed integrally with expanded metal, thus providing rigidity.

15.3 Welded wire mesh. Plain welded wire mesh should be galvanized after manufacture in accordance with the requirements of BS 729 or be of stainless steel. It should be of 25 mm to 50 mm mesh and have wires not less than 1.02 mm diameter. Welded mesh of this kind is used primarily as a reinforcement when rendering over certain backgrounds. Other types of welded mesh are available as proprietary materials. One type, which is self-firring, is manufactured from wires galvanized in accordance with the requirements of BS 443 and includes additional stainless steel wires and an interwoven layer of absorptive paper. A water-resistant breather paper is fixed to the back. It has a mesh aperture of 38 mm x 50 mm. This type is designed to be fixed principally with stainless steel fixings.

15.4 Galvanized wire netting. Netting should be of 20 mm to 38 mm mesh and comply with the requirements of BS 1485.

16. Fixings

16.1 Nails and pins. Nails should comply with the requirements of BS 1202 : Part 1 and should be galvanized or of stainless steel. Pins for shot-firing should be of steel with a tight coating of cadmium or zinc in accordance with the requirements of BS 1706.

16.2 Staples. Staples should be galvanized or of stainless steel.

16.3 Screws and bolt fixings (including expanding bolts and drill anchors). Screws and bolt fixings (including expanding bolts and drill anchors) should be of stainless steel or of steel protected with a coating of cadmium or zinc in accordance with the requirements of BS 1706 or BS 4921.

16.4 Washers and ancillary angles, brackets or cleats. Washers and ancillary angles, brackets or cleats are often used in conjunction with shot-fired or screwed fixings. They should be galvanized or otherwise suitably coated in accordance with the requirements of BS 4921, BS 1706 or BS 2989.

16.5 Wire. Galvanized wire should be soft galvanized in accordance with the requirements of BS 443.

Stainless steel wire should be soft and comply with the requirements of BS 1554.

16.6 Fixing blocks in solid backgrounds. Only dovetailed shaped blocks which can be cast in should be considered. The use of wooden blocks is not advised. Some types of plastics, e.g. high density polyethylene, and some cement based blocks have proved satisfactory.

16.7 Plugs. Plugs for inserting into pre-drilled holes and to receive screws are available as proprietary products made from jute fibre or various types of plastics. Wooden plugs are not recommended.

NOTE. It is recommended that those responsible for the rendering satisfy themselves on the adequacy of any method of fixing before commencing work (see clauses 4 and 5).

17. Firring

When rods or strips are used, these should be not less than 6 mm thick and should be of steel, zinc coated in accordance with the requirements of BS 729, or of timber which has been given preservative treatment (see 20.5.2).

Section three. Backgrounds

18. Characteristics

Renderings are applied to backgrounds specifically designed and erected to receive them or may be applied to an existing wall for the purpose of increasing durability, reducing rain penetration, to cover an unsightly surface or to obtain a particular decorative effect. The nature of the background to which a rendering is applied is important and should be the prime consideration in deciding upon the mixes to be used, the number of coats and the type of finish. Properties which may influence this choice are as follows.

18.1 Strength. The strength of the background should be adequate for the rendering which is to be applied.

18.2 Porosity and suction. Porosity and suction affect the adhesion of the rendering and influence the selection of the type of mix to be used from the point of view of the method of application, type of finish and weather resistance.

18.3 Mechanical key. Mechanical key may be afforded by the nature of the background or artificially provided.

18.4 Inherent resistance to penetration of rain. Some backgrounds are impervious to rain penetration without a rendering, others are not; the type of rendering applied should be designed to suit the circumstances.

18.5 Protection required. Some materials will have adequate performance only when protected by suitable renderings. This factor will influence the choice of mix, particularly for undercoats.

18.6 Other properties which may affect the behaviour and durability of the rendering. If the background becomes wet and remains so for significant periods, deterioration of the rendering may be caused by chemical action between the rendering and soluble matter contained in the background, or by physical effects such as excessive differential expansion or contraction or movement of the background (see clause 39). These may well result in loss of adhesion, or cracking or disintegration of the rendering itself. It is of prime importance therefore that the construction should be designed so that the background does not remain wet for long periods. This is particularly important on backgrounds which contain soluble sulphates (see clause 34).

19. Types

Backgrounds to which renderings are normally applied can be divided as follows.

19.1 Solid backgrounds. Solid backgrounds vary considerably in strength, suction and mechanical key and may be further classified as follows.

19.1.1 Dense, strong and smooth materials, which include high density clay or concrete bricks and blocks and dense and closed surface lightweight aggregate concrete (including expanded clay, sintered pulverized fuel ash and wood chip concrete), either pre-cast or in situ. These have low porosity and little suction and frequently have smooth surfaces which do not afford a mechanical key. Drying shrinkage of dense clay bricks or blocks is negligible, for dense concrete it is

usually moderate but for lightweight aggregate concrete it may be high. Moisture expansion of some clay bricks when used fresh from the kiln can be significant.

Generally there is difficulty in securing a satisfactory bond between the rendering and the background so that some means of ensuring good bonding is often necessary. Bush-hammering, or the use of metal lathing, or of close centred indented keys or the use of keyed bricks or blocks are normally satisfactory; another method is to use a spatterdash key coat.

Provided jointing is satisfactory, backgrounds of this class are sufficiently weather resistant without rendering. Efflorescence of soluble salts on the surface of the background is less likely than with more porous materials.

19.1.2 Moderately strong and porous materials, which include most clay, calcium silicate and concrete bricks and blocks and some medium density concrete, either pre-cast or in situ. These backgrounds usually afford some suction and mechanical key and hence provide a satisfactory bond. Clay bricks and blocks contain soluble sulphate salts and when these are present in significant amounts, if water gains ingress to the background, expansion of the mortar joints may take place resulting in cracking and eventual loss of adhesion of the rendering. If the suction of the background is irregular, a spatterdash treatment is recommended.

19.1.3 Moderately weak and porous materials, consisting mainly of open surface lightweight aggregate concrete, aerated concrete and some bricks having relatively low strength, need more care in the selection of rendering treatment than the backgrounds described in 19.1.2. It is particularly important that renderings should not be too strong for the background since shrinkage of the rendering is liable to lead to shearing of the surface of the background. Risk of the presence of soluble salts exists with some clay products as described in 19.1.2.

19.1.4 No-fines concrete forms a class by itself. It has many large voids and affords an efficient mechanical key for rendering; it generally has sufficient strength to resist shrinkage stresses imposed by the rendering. It has few small pores, and the resulting low capillarity avoids trouble arising from excessive suction; the risk of capillary transmission of water through the walls is very small.

19.2 Slab backgrounds. Woodwool slabs are the only type of slab likely to be employed as a background for rendering. They may be used as permanent formwork for concrete floors and walls or may be fixed over studding. Woodwool has many large voids and affords a good mechanical key for the rendering. The material is, however, weak and when unrestrained cannot resist undue stresses imposed on it by movement of the rendering due to moisture change. Further, woodwool is itself subject to high moisture movement and it is therefore essential that the slabs are completely dry before rendering is carried out.

19.3 Metal lathing. Expanded metal or welded wire mesh as a background for external rendering is principally used with framed construction. Three coat work is essential, with a dense and relatively impervious first coat to achieve the necessary resistance to rain penetration and to prevent rusting of the lathing.

20. Preparation of background

It is important that surfaces to be rendered should be cleaned of all residual mould oil, dust and loose particles.

Organic growths (fungi, algae, etc.) should be killed by treatment with a toxic wash and the dead, dry material brushed off after a suitable interval (see BRE Digest 139*).

The fixing of any attachments necessitating cutting into the background should be carried out before the rendering is begun. Fixings for pipes and other attachments should project sufficiently to clear the final coat. If dubbing out is needed, it should be done well in advance of the application of the first undercoat, using a mix at least as strong and thicker than the first undercoat but not stronger than the background. If the thickness needed is greater than 16 mm it should be built up in two or more coats, each coat not more than 16 mm thick.

Before applying the undercoat, solid backgrounds may require wetting to control suction. The amount of wetting required will depend on the nature of the background, type of mix being used, method of application, aspect and weather conditions. Care is necessary to ensure that parts of the surface that dry out are re-wetted before rendering is applied. Over-wetting of background surfaces of low absorption can on the other hand lead to poor adhesion and slumping of the rendering and with more absorbent background materials could result in subsequent shrinkage movement of the background or the development of unsightly efflorescence or lime bloom.

20.1 Concrete, including in situ and precast. Concrete may be prepared to receive a subsequent rendered finish either when cast and immediately the formwork is removed or after the concrete has hardened.

20.1.1 Prior treatment. Techniques employed are to expose the aggregate or to provide indented keys as follows.

(a) With pre-cast units the surface of the concrete can be removed to expose the aggregate. This may be done by using a fine spray of water or by washing and brushing with a soft bristle brush.

(b) Surface retarders applied to the formwork may be used but require considerable care in use if good results are to be achieved. The whole of the concrete surface should be uniformly exposed and thoroughly washed and brushed to ensure that all loose materials and unset cement are removed.

(c) Metal lathing may be fixed to the formwork so that when this is struck, the surface skin of the concrete is removed, thus exposing the aggregate and leaving a roughened surface.

(d) Indented keys may be provided using rubber or composition formers fixed to the shuttering.

Alternatively, small diameter rope may be nailed to the formwork at about 75 mm centres; plastics fibre rope is not generally satisfactory for this purpose.

The success of methods (b), (c) and (d) are dependent upon the formwork being struck when the concrete is at an appropriately early age.

20.1.2 Subsequent treatment. The density, smoothness and suction of concrete will vary. If there is adequate natural key and sufficient suction it may be possible to render direct. Laitance and efflorescence should be removed, preferably by dry brushing. Ridges or fins on concrete left by shuttering imperfections should be removed before cleaning. Concrete should be washed down with clean water; grease and/or mould oil may require scrubbing with water containing a suitable detergent but this in turn should be removed by subsequent washing with clean water.

* Building Research Establishment Digest No. 139 'Control of lichens, moulds and similar growths' HMSO 1972.

Dense, smooth concrete with low suction will require the provision of a mechanical key. The following techniques may be considered.

(a) *Hacking.* This may be done by hand or mechanically, e.g. hacking, bush hammering or abrasive blasting. It is not effective unless the whole of the surface is roughened by removing to a depth of at least 3 mm to expose the aggregate. After scarifying, the surface should be washed and brushed.

(b) *Spatterdash treatment.* The suction of the background will probably dictate the best technique to adopt. If there is some suction, a cement/sand dash is generally satisfactory. The mix should consist of one part cement and one and a half to two parts of clean, fairly coarse sand, mixed with sufficient water to give the consistency of a fat mortar or thick slurry. It is important that the mixture be kept well stirred. The background should be cleaned and dampened and the mix dashed on with either a trowel or scoop to give a thin coating with a roughcast uneven appearance. To prevent rapid loss of moisture and insufficient hydration the spatterdash should be dampened periodically and then permitted to dry out slowly and harden before the application of the undercoat.

On backgrounds with negligible suction, the following alternative treatment might be adopted. One part cement and one and a half to two parts of clean sharp sand is gauged with water to which a proportion of PVA emulsion, as recommended by the manufacturers, has been added to give the consistence of a thick slurry. The mixture should be vigorously brushed into the surface and immediately stippled with a banister or similar brush to form a key. It is of paramount importance when adopting this technique that the material is properly stippled to provide a deep, close textured key; the mixture should not be merely brushed on in the form of a slurry coat. Another method which may be employed is to mix the material to a somewhat thicker consistency and apply it with a notched trowel so that a ribbed key is provided. To ensure proper hydration, the spatterdash should be dampened periodically and then permitted to dry out slowly and harden before the application of the undercoat.

(c) *Bonding treatment.* Emulsions of styrene-butadiene rubber and acrylic resin have been used. They are normally mixed with cement to form a slurry, scrubbed onto the surface of the wall and the undercoat applied immediately. Because sufficient long term experience is not yet available, no specific recommendations for their use are given in this code.

NOTE. Bonding coats based on gypsum plaster should not be used under any circumstances.

(d) *Fixing metal lathing to provide a key.*

The recommendations given in clause 20.5 should be followed.

20.2 Clay bricks and blocks. Joints of brickwork to be rendered should be raked out during construction and any efflorescence removed by dry brushing. Any bricks that project enough to interfere with the rendering should be cut back. The joints of keyed bricks and blocks do not need raking out.

Where the joints have not been raked out during construction, the procedure described below for rendering on old brickwork should be followed.

Old brickwork should be examined to ascertain whether it will provide an adequate key. Soft joints should be raked out to a depth of not less than 10 mm; if the mortar is hard, raking out may be so costly that other methods of providing a key may be preferable (see 20.1.2). Where the surface has been treated with paint, distemper, oil or any other water repellent materials that destroy the natural key, or where it is impracticable to rake out the joints, metal lathing can be used or the surface may be thoroughly hacked to provide a key. Where the bricks themselves are disintegrating or are so soft that they are unlikely to support a rendering, metal lathing should be used, always providing that it can be securely fixed to solid parts of the wall (see 20.5).

20.3 Calcium silicate and concrete bricks and blocks. The surface texture of calcium silicate and concrete bricks and blocks is often sufficiently open to provide a mechanical key without the need for joints to be raked out. Some materials of higher strength and density, however, may have smooth surfaces providing little key and should be treated as for concrete or brickwork.

20.4 Woodwool slabs. The slabs should have tight butted joints; any incidental gaps at the joints should be filled with cement mortar. Joints and angles should be reinforced with galvanized metal scrim, which may be of a proprietary self-stapling type. Alternatively, the whole surface of the slabs may be overlaid with wire netting or light welded wire mesh reinforcement fixed with galvanized nails or staples at not more than 300 mm spacing in both directions. It is sometimes difficult to obtain firm fixing into woodwool and nails or staples should be driven at an angle ensuring that the netting or mesh is stretched tight.

When the background is formed of channel reinforced slabs, the joints should be covered with a strip of expanded metal approximately 250 mm wide fixed with galvanized nails or staples driven at an angle.

Three coat work is recommended on woodwool slab backgrounds, the first undercoat being thrown on from a trowel or scoop in similar fashion to the application of a spatterdash. Sufficient time must be allowed for this coat to shrink and dry out completely before the second coat is applied. In warm dry weather, the thrown coat should be dampened periodically to ensure proper hydration and then be permitted to dry out slowly and harden before the application of the undercoat.

20.5 Metal lathing. Where possible, expanded metal should be fixed with the long way of the mesh across the supports. If the latter are more than 350 mm apart, the gauge of the metal should be increased above that normally used, according to experience, to give sufficient rigidity. Ribbed lath and some welded wire mesh have greater rigidity and when used may have supports up to 600 mm apart.

The strands of expanded metal should all slope in one direction; in vertical work they should slope inwards and downwards from the face of the rendering.

Manufacturers' instructions regarding lapping and tying sides and ends of sheets of lath should be complied with as these will vary for different types of lath. Laps should, however, never be less than 25 mm or one mesh, whichever is the greater. Sides of sheets should be wired together with galvanized wire 1.2 mm diameter at approximately 100 mm (10 ties per linear metre) between supports; cut ends of wire used for tying laps or for fixing should be pushed flat against the lath so that the ends do not protrude through the rendering.

20.5.1 Over smooth concrete, stone, painted brickwork and like backgrounds. Lathing should be fixed to the background at spacings recommended by the manufacturers for the type and gauge of lathing employed. When additional furring strips are required these should be of galvanized steel (see clause 17).

Some recommended methods of fixing metal lathing are as follows.

- (a) Nailing into suitable cast-in blocks with washers over the lathing.
- (b) Screwing into plugs inserted into predrilled holes, with washers over the lathing.
- (c) Shot-fired pins with washers over the lathing.
- (d) Expanded type screw fixings with washers over the lathing.
- (e) Wiring on to prefixed galvanized metal channel sections, angles or cleats, or to screwed fixings.

Alternatively, the background may be battened out using preserved timber battens at centres appropriate to the type of lath, and the lath fixed as described in 20.5.2; the breather paper may however be omitted.

20.5.2 Over timber framed construction. Before fixing lathing, the studding should be overlaid with a water-resistant breather paper complying with the requirements of BS 4016. Any of the types of metal lathing described in clause 15 may be employed, fixed in accordance with the manufacturer's instructions. The type and gauge of the lathing employed will be largely dependent upon the spacing of the timber studding, which should not exceed 600 mm.

If the timber framing is sheathed with plywood or chip-board, the breather paper must be fixed over it. Lathing should then be fixed at spacings recommended by the manufacturers for the type and gauge of lathing employed. When additional furring strips are required these should be of preserved timber and should be fixed vertically (see clause 17).

20.5.3 Over metal framed construction. Any of the types of metal lathing described in clause 15 may be employed. Fixing is normally done by wiring on in accordance with the manufacturer's instructions. The type and gauge of the lathing employed will be largely dependent upon the spacing of the frame members. It is sometimes necessary to fix additional angles or straps to provide fixing points at the correct intervals. These should be of adequate dimensions to support the lathing satisfactorily and should be zinc coated. The additional angles or straps should be fixed by wiring on or with shot-fired pins or screwed fixings, as described in 16.4.

For fire protection of steel columns or beams, metal lathing may be spaced from the structural member by a spiral of 6 mm mild steel at 300 mm pitch, wrapped round the member before the lathing is fixed. Alternatively, cradles or stirrups of mild steel rod may be fixed to the member; spot welding is a frequently used method of fixing. When self-fired metal lathing is employed, the use of spacing stirrups is not essential.

NOTE. When rendering is applied to a solid background and proper bond is obtained, considerable restraint against differential movement is achieved but movement joints should be provided at appropriate intervals. Rendering on metal lathing or woodwool slabs fixed to timber or steel framed construction can however be subject to movement of the background and special provisions for crack control may be necessary (see clause 30).

Section four. Design

21. Factors influencing the selection of a rendering mix

When preparing a specification and details, the designer should take account of the following.

21.1 Choice of rendering mixes. This will depend upon the appearance desired, exposure conditions, nature of the background and the functional requirements. These factors should therefore receive consideration together. Experience has shown that a porous rendering not stronger than required for adequate durability and with an open or rough textured finish is likely to give the best results in the majority of circumstances.

21.2 Preparation of the background. The method adopted will be dictated by the type of background. Consideration will need to be given to the method of forming a key and to any materials to be used, including metal lathing. Consideration will also need to be given to the fixing of any devices to be built into or attached to the background for support when adhesion cannot be relied upon.

21.3 Detailing of architectural features. Proper detailing of items such as copings, eaves and verges, string courses, damp-proof courses, flashings, plinths and bellcasts have considerable bearing upon the durability of the rendering.

22. Mixes

The composition of mixes types I to IV are given in table 1; mixes recommended for use in different combinations of circumstances are given in table 2.

In table 2, where alternative mixes are given the following considerations apply in deciding which should be used.

- (a) The type of mix shown in bold type is to be preferred. The mix for each successive coat should never be of a type richer in cement than the mix used for the coat to which it is applied.
- (b) The type of mix richer in cement is to be preferred when it is applied under winter conditions.

22.1 Type I mixes. These produce strong, relatively impervious renderings with high drying shrinkage and consequently high susceptibility to cracking. It is recommended that their use is restricted to strong backgrounds and for the following applications.

- (a) As first coats on metal lathing or no-fines concrete backgrounds.
- (b) Roughcast or dry-dash finishes.
- (c) Special abrasion resistant applications, such as plinths, etc.

22.2 Type II, III, IV mixes. These are likely to provide satisfactory results in most types of rendered finish and under most conditions. They are more porous than type I mixes and have a lower drying shrinkage. Their strength is adequate for the conditions laid down in the table. Type III and IV mixes particularly are less liable to cracking and crazing. The mixes lowest in cement content may not be sufficiently hard to deter vandals or to withstand severe abrasion.

22.3 Spatterdash mixes. These have been adequately described in 20.1.2(b).

22.4 Machine-applied decorative finishes. These are normally supplied as ready-mixed proprietary materials and should be used in accordance with the manufacturer's instructions.



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22.5 Mixes containing fibres. When hair or fibres are included in the first coat on metal lathing or like backgrounds, 5 kg of fibres are required per cubic metre of mortar (see clause 10).

23. Number and thickness of coats

An external rendered treatment should not have less than two coats, applied at adequate intervals to allow each coat to dry out and shrink before applying the next. One undercoat followed by a finishing coat will normally prove adequate. Extra coats will, however, often be necessary, for example on metal lath and woodwool slab backgrounds and where increased resistance to rain penetration is required.

23.1 Spatterdash. Spatterdash in addition to the undercoats may be necessary to provide a good bond or to reduce or even out the suction of the background. Spatterdash will normally be 3 mm to 5 mm thick.

23.2 Undercoats. Undercoats serve various purposes. They provide a means of straightening or levelling an uneven surface and are often the most important part of the treatment in preventing rain penetration; they provide a surface of even suction and good adhesion for the finishing coat and over areas of differing suction they minimize 'grinning' of joints through the finishing coat. A first undercoat should not exceed 16 mm or be less than 8 mm in thickness in any part. Undercoats of at least 10 mm thickness are preferable on weak backgrounds. Subsequent undercoats should be between 6 mm and 10 mm thick. If greater thickness is required to build up an even surface, additional undercoats should be used. Two undercoats will be required where the finishing coat does not provide a continuous solid layer, as in some machine-applied finishes, also on metal lathing and woodwool slabs to obtain resistance to rain penetration and to protect the background. Where accessible, metal lathing should also be back-rendered.

23.3 Final coat. The thickness of the final coat will be governed to some extent by the texture required, but will normally be 8 mm to 11 mm as finished. Plain (float) finishes will be between 5 mm and 8 mm thick. Some of the finer textured machine-applied finishes may be as thin as 3 mm. The total thickness of rendering over metal lathing should be at least 16 mm.

24. Types of finish

The finishes for external renderings may be classified as

- float finish
- scraped or textured, hand applied
- rough cast, wet thrown by hand
- dry-dash, dry-thrown by hand
- machine-applied, hand-operated 'flicking' machine or power spray

24.1 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.

24.2 Scraped or textured finishes. Scraped or textured finishes are generally less liable to crack or craze than plain finishes and any small cracks are less likely to be seen. They are easier to bring to a uniform appearance, which is particularly important when coloured renderings are used. Although offering more lodgement for dirt, a rough texture tends to an evenness of discoloration which makes the dirt less apparent than with a smoother finish. Also, the distribution of the flow of rain water over a textured surface

tends to reduce the risk of penetration through the rendering.

24.3 Hand-thrown finishes. Rough-cast and dry-dashing have most of the advantages of scraped or textured finishes. Under severe conditions of exposure they are more satisfactory from the points of view of weatherproofness, durability and resistance to cracking and crazing than any of the foregoing. These finishes are less suitable for use over relatively weak backgrounds.

24.4 Machine-applied finishes. Machine-applied finishes are of various types, mainly using proprietary materials and process which, depending on the system, may require to be carried out by skilled applicators. The material is usually thrown or sprayed on in discrete particles, has an open porous structure, behaves similarly to hand-applied scraped finishes and, dependent on the backing, can be equal to the latter and to hand-thrown finishes in waterproofness, durability and resistance to cracking and crazing. When applied over backgrounds which are not resistant to water penetration, two undercoats are required for this type of finish.

24.5 Special aggregates. Special aggregates such as mica or spar may be used to give life or contrast to scraped, textured or dry-thrown finishes.

25. Colour

Only the finishing coat need be coloured and this can be done by the following means.

- (a) Using a suitable sand or other aggregate. If delicate coloured effects are desired the aggregate should be most carefully selected to give the required effect in the finished rendering; a consistent supply should be assured.
- (b) Using suitable pigments (see clause 9). When light colours are required it is preferable to use a white Portland cement; other cements have a deadening effect upon most colours. Lime added to a coloured mix will lighten the colour. It is not easy to achieve consistency when adding pigments to mixes on site. It is therefore recommended, except when only a small quantity is required, that coloured ready-mixed lime:sand for mortar be used. Ideally, a sufficient quantity to complete the work should be obtained at one time. The material not being used should be kept covered to protect it from the weather.

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

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 incorrectly as 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. Recommendations on the choice of suitable colours are given in BS 5252 'Framework for colour co-ordination for building purposes'.

The effect of atmospheric pollution and discoloration by sooty deposits should be taken into account. The recommendations made in clause 35 are particularly important with coloured finishes.

* In course of preparation.