BRITISH STANDARD

BS 5262:1991

Code of practice for

External renderings

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Elements and Components (of Diverse Materials) for Buildings Standards Policy Committee (ECB/-) to Technical Committee ECB/5, upon which the following bodies were represented:

Aggregate Concrete Block Association
Association of Lightweight Aggregate Manufacturers
British Aggregate Construction Materials Industries
Building Employers Confederation
Chartered Institute of Building
Concrete Society
Contract Flooring Association
Department of the Environment (Property Services Agency)
Department of the Environment (Building Research Establishment)
Federation of Association of Specialists and Sub-Contractors
Federation of Plastering and Drywall Contractors
Institution of Structural Engineers
Mastic Asphalt Council and Employers' Federation
Mortar Producers' Association Limited
National Federation of Terrazzo — Mosaic Specialists
Royal Institute of British Architects
Sand and Gravel Association Limited
Scottish Master Plasterers' Association
Society of Chemical Industry

The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

Autoclaved Aerated Concrete Products Association
External Wall Insulation Association
National House-Building Council

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Contents

Foreword

This British Standard has been prepared under the direction of the Elements and Components (of Diverse Materials) for Buildings Standards Policy Committee. It is a revision of BS 5262:1976, which is withdrawn.

The standard gives recommendations for building details, design and materials considerations, the selection of mixes and the application of cement-based external renderings.

A rendered finish may be applied to a variety of backgrounds, either to improve resistance to rain penetration and weathering or for aesthetic reasons.

In this edition of BS 5262, account has been taken of recent investigations into rendering failures. Recommendations for polymer-modified renderings and rendering over external insulation have been included.

It has been assumed in the drafting of this standard that the application of its provisions is entrusted to appropriately qualified and experienced people, for whose guidance it has been prepared.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to vi, pages 1 to 36, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

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Section 1. General

1 Scope

This code of practice gives recommendations for cement-based external renderings on all common types of background. 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.

NOTE 1 For renderings to receive external tiling and mosaics, see BS 5385-2.

NOTE 2 The titles of the publications referred to in this standard are listed on page 36.

2 Definitions

For the purposes of this British Standard, the definitions given in BS 6100-6 apply.

3 Exchange of information

The working drawings and specifications should be prepared in sufficient detail to afford proper guidance in the execution of the work.

When preparing rendering details the designer should take into account the following points.

a) The choice of type of rendering to be used depends on the functional requirements, the nature and conditions of exposure of the background and the aesthetic requirements. The nature of the background may dictate the type of rendering finish that can be applied and, therefore, the background and rendering system should be considered together.

b) The area and types of finish and thickness required together with sufficient details of the surfaces to be rendered, architectural features such as string courses, sills, positions of damp-proof courses, etc., to enable the most suitable rendering materials and methods to be selected.

c) The possibility of a bonding treatment being required to ensure good adhesion between the rendering and the background.

d) The likelihood of inclement weather (see **45.1**).

e) The type of scaffolding to be used and items in need of protection (see clauses **40** and **41**).

f) The method of curing required. (See **45.2**.)

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.

At a reasonable time prior to work commencing, all necessary working drawings should be provided and the site should be visited to monitor building progress. Arrangements should then be made for any necessary preparatory work to be carried out without causing delay to work that is to follow.

4 Building programme

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

When considering the programme for machine-applied rendering, it should be remembered that mechanical methods of application can cover larger areas in shorter periods than traditional methods and therefore a greater area should be made available within the programme to allow for this.

In preparing the programme, each operation should be considered in relation to the others, and due consideration should be given to the economical use of construction plant, equipment and scaffolding by all trades. Consideration should also be given in the programme to ensuring that the various trades follow one another in a correct sequence and do not interfere unduly with each others' work. The programme should be carefully planned to avoid risk of serious damage or difficulties occasioned to or by other trades.

The programme 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 programme 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.

A detailed programme for the work, prepared in consultation with those responsible for the general building contract, should be maintained.

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

Section 2. Materials

5 Cements

Cement should comply with one of the following British Standards BS 12; BS 146; BS 4027; BS 5224.

6 Limes

Building limes should comply with BS 890.

7 Aggregates

7.1 Sands

The quality of sands, especially for final coats, should ideally comply with clause **5** of BS 1199:1976. Sands should preferably comply with grading type A in Table 1 of BS 1199:1976. Experience has shown that some sands which do not comply strictly with BS 1199 can give satisfactory results. However, finer sands should only be used with extreme caution. It is recommended that enquiries be made regarding locally available sands and their uses. 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. 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. For others, such as "torn" textures, a slightly larger proportion of material coarser than the 5 mm size (see Table 1 of BS 1199:1976) may be needed.

NOTE 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.

7.2 Coarse aggregate

Natural aggregate other than sand should comply with the appropriate clauses of BS 882 or BS 63-2.

7.3 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 British Standards where applicable.

8 Pigments

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

9 Fibres

Fibres may be used in specialized applications such as restoration work, sprayed renderings and renderings on lathing or insulation boards.

Natural fibres should be dry, clean and free from oil or grease.

Alkali-resistant mineral fibres and several types of polymer fibres can be used, both as loose fibre and in premixes. Manufacturers' literature should be consulted for likely improvements to the rendering as well as limitations on use and long term deterioration.

Metal fibres should be of a type that is not adversely affected by alkaline or weak acid conditions.

10 Admixtures

10.1 General

With all admixtures it is essential that the manufacturer's instructions be precisely followed. Overdosage should be avoided:

10.2 Plasticizers

Organic plasticizers to improve workability should comply with BS 4887-1.

NOTE Plasticizers and/or air-entraining agents should not be used in mortars made with masonry cement complying with BS 5224.

10.3 Waterproofers

Integral waterproofers are available as proprietary materials.

10.4 Water-retentive agents

Water-retentive agents are normally cellulose derivatives and are available as proprietary materials.

10.5 Polymer dispersions

Polymer dispersions may be used to improve bond strength, resistance to water penetration and durability. Styrene-butadiene rubber (SBR) and acrylics fall into this category.

11 Bonding agents

Proprietary bonding agents based on styrene-butadiene rubber (SBR) and acrylic polymers improve the adhesion of renderings to smooth surfaces and to low or high suction backgrounds, if incorporated in spatterdash, stipple, adhesive slurry or undercoat mixes. Bonding agents can also promote the hydration of such mixes applied to absorbent surfaces. Manufacturers' instructions concerning the use of these products should be carefully observed.

Where bonding agents are applied directly to backgrounds, it is essential that succeeding renderings be applied before the bonding agent is allowed to dry out, otherwise debonding is likely to occur.

12 Water

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

13 Ready-mixed rendering materials

13.1 Ready-mixed lime : sand

Ready-mixed lime : sand for mortars should comply with section 2 of BS 4721:1981 and should be mixed with cement on site. Ready-mixed lime:sand may be supplied with pigments (see clause **8**) and/or fibres (see clause **9**) and/or admixtures (see clause **10**) where their use is specified.

NOTE Clause **31** gives recommendations on mixes.

13.2 Retarded ready-to-use cement : lime : sand or cement : sand

Ready-to-use mortars should comply with section 3 of BS 4721:1981 and require no additions on site. (In certain conditions small amounts of clean water may be added, e.g. to replace that lost by evaporation, to maintain the optimum consistency.) Ready-to-use mortars may be supplied with pigments (see clause **8**) and/or fibres (see clause **9**) and/or admixtures (see clause **10**) where their use is specified.

13.3 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 BS 5262. Mix proportions and mixing instructions should be clearly stated on the bags.

13.4 Proprietary materials

Users of proprietary rendering materials should satisfy themselves that they are suitable for their intended purpose. The proprietary rendering materials should be applied as recommended by the manufacturer. Included in the proprietary rendering materials that are available are one-coat materials.

14 Reinforcement, metal lathing and beads

14.1 General

All metal reinforcement, lathing and beads of whatever type should be stainless steel or galvanized and should be suitable for external use.

14.2 Expanded metal

Expanded metal should be as specified in BS 1369-1.

14.3 Ribbed lathing

Ribbed lathing should be as specified in BS 1369-1. Ribs are formed integrally with expanded metal thus providing rigidity.

14.4 Welded wire mesh

Plain welded wire mesh should be galvanized after manufacture in accordance with BS 729, or should be of stainless steel. It should be of 25 mm to 50 mm mesh and have wires not less than 1.2 mm diameter. Welded mesh of this kind is used primarily as a reinforcement when rendering over certain backgrounds.

14.5 Non-metallic mesh

Non-metallic mesh should be made from alkali-resistant mineral fibres or plastics.

14.6 Beads and stops

Angle beads, stop beads and render stops should be made from stainless steel that has a corrosion resistance at least equal to Grade 304 of BS 1449-2.

Beads and stops made from galvanized steel with a coating of at least Grade 275 as given in BS 2989 may be used provided the arrisses and exposed faces are protected by epoxy coating or polyvinyl chloride (PVC) nosing sheaths. Galvanized bell cast beads may be used without the additional protection.

15 Fixings

15.1 General

The fixings for lathing and beads should be made of a compatible material.

15.2 Nails and pins

Nails should comply with BS 1202-1 and should be galvanized or of stainless steel. Pins for shot-firing should be of steel with a coating of cadmium or zinc in accordance with BS 1706.

15.3 Staples

Staples should be made of stainless steel.

15.4 Screws and bolt fixings

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 BS 1706 or BS 4921.

15.5 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 BS 1706, BS 2989 or BS 4921.

15.6 Wire

Galvanized wire should be soft galvanized in accordance with BS 443.

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

15.7 Fixing blocks in solid backgrounds

Only dovetailed shaped blocks which can be cast in should be considered. Wooden blocks should not be used. Some types of plastics, e.g. high density polyethylene, and some cement-based blocks have proved satisfactory.

15.8 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 should not be used.

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 **3** and **4**).

16 Firring

Firrings should consist of galvanized or stainless steel channels, rods or strips of timber. Rods or strips should be not less than 6 mm thick. Galvanizing should be in accordance with BS 729. Timber should have been given preservative treatment (see **38.7.3**).

Section 3. Design

17 Factors influencing the design of the rendering system

17.1 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. Problems can occur with mixes that are too strong. Successive render coats should be specified as being no stronger than the previous coat or background, and no thicker than the previous coat, except in the case of a single coat (see clauses **27**, **31** and **32**).

17.2 Provision of joints

Consideration should be given to the provision and location of movement joints and day joints in large areas of background and rendering (see clause **27**). Except at movement joints, straight vertical joints in masonry should be avoided.

17.3 Preparation of background

The method adopted will be dictated by the type of background. Consideration should be given to the method of forming a key and to any materials to be used, including metal lathing. Consideration should also be given to the fixing of any devices to be built into, or attached to, the background for support.

17.4 Detailing of architectural features

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

In order to minimize damage to the rendering, consideration should be given to fixings, for rainwater, soft and vent pipes, etc., being installed before rendering commences. The pipes themselves should be fixed after the wall has been rendered (see Figure 1).

18 Conditions of exposure

Rendering is affected to a greater or lesser degree by the combined action of frost, wind, sun and rain, and their effects will depend to some extent upon the degree of exposure. Altitude, locality and environment will have a bearing on the severity of frost. A classification of exposure to local wind-driven rain is given in Table 10 of BS 5628-3:1985. This table defines exposure categories in terms of the local spell index as described in DD 93 and in terms of exposure categories: severe; moderate and sheltered. These three exposure categories are broader than those derived from DD 93, but generally will be adequate for the purposes of external renderings. The degree of exposure to wind and rain may be assessed by the use of the "driving-rain index" and the direction of the prevailing weather can be judged by the "driving-rain roses" (see Figure 2 and Figure 3). Even so, the designer should always take into consideration local knowledge and experience when deciding which exposure category is the most appropriate.

The categories of exposure can be described broadly as follows:

a) *severe conditions*: exposure to the full force of wind and rain. Applies to buildings on hill sites and near the coast, and buildings projecting well above surrounding buildings in built-up areas;

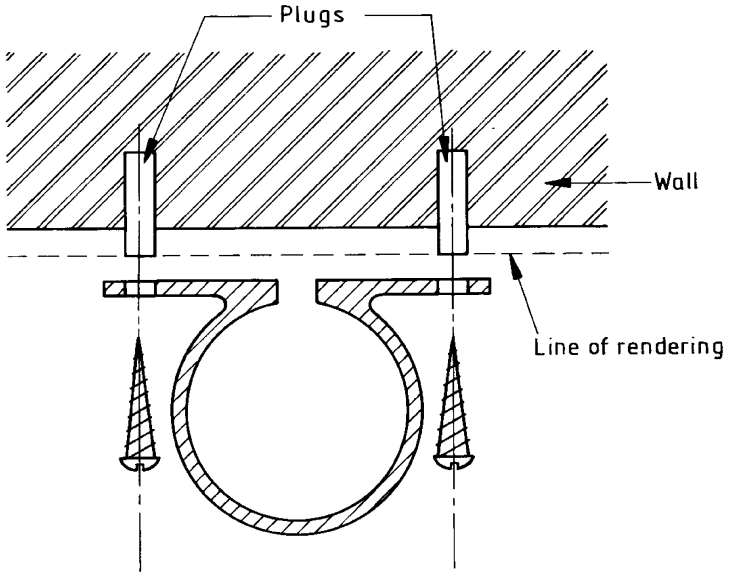
b) *moderate conditions*: walls are partially protected from the weather by overhanging eaves and by other buildings of similar height in the neighbourhood. Applies to buildings in towns and in suburban districts generally;

c) *sheltered conditions*: districts of moderately low rainfall in which walls are protected from the weather by overhanging eaves and by the close proximity of buildings of similar, or greater heights. Ground and first storeys in towns.

Wherever possible, whatever the conditions of exposure, advantage should be taken of architectural features which protect the rendering (see clause **29**). Such protective features become more important as conditions become more severe. Mixes appropriate to these categories of exposure are given in clause **31**.

19 Resistance to rain penetration

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, breaks up the flow and so avoids the concentration of water at any one point.



NOTE. Pipe bracket is shown as an example.

Figure 1 — Fixings installed in wall before rendering

A porous rendering will generally absorb some water falling directly on it and retain this until conditions change and it can evaporate outwards. The denser and more impermeable the rendering, the less water it will retain and the greater hindrance to the evaporation of water which has penetrated to or condensed within the background. For resistance to rain penetration, rough surface texture is normally more effective than a dense and impermeable plain finish.

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

Where cracks occur, water may enter and find its way between the rendering coats, or between the rendering and the background, or directly into the background. A build-up of moisture has also been known to occur where there is a lack of drainage and/or ventilation in cavities of existing rendered brickwork filled with insulation. The water is liable to 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. Also, it may soak through solid walls and cause dampness, loss of adhesion or disintegration of plasterwork inside.

Exposure conditions, coupled with the amount of protection given to the rendering by projecting features (see clause **29**) should be considered in deciding upon the type of rendering, the number of coats and the nature of each coat, subject always to the limitations imposed by the nature of the background.

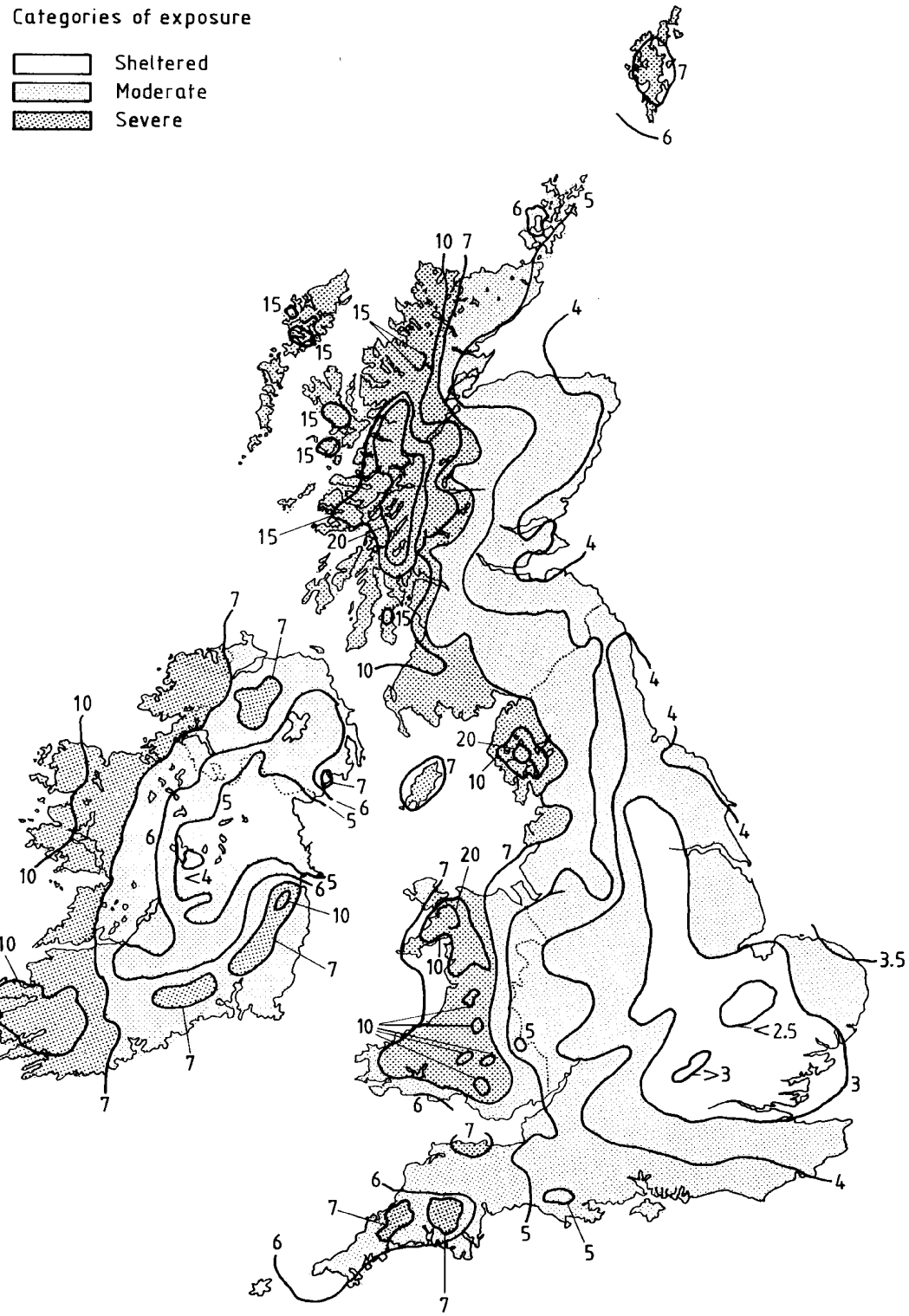


Figure 2 — Annual driving-rain index: British Isles

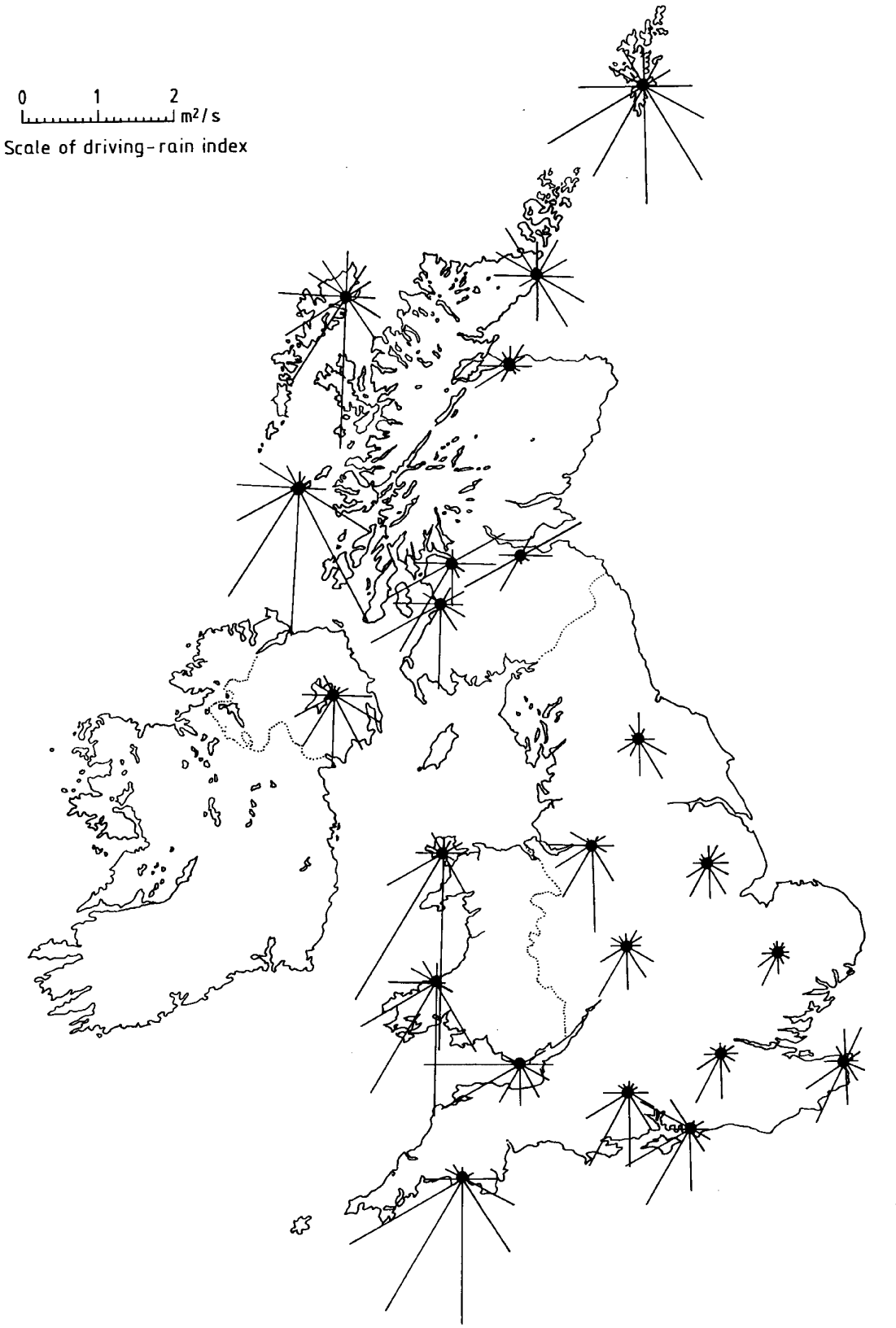


Figure 3 — Annual relative driving-rain index for each of eight wind directions at 20 stations

Some backgrounds, such as dense concrete, are resistant to water penetration. For other backgrounds which are dependent upon the rendering for protection, the following general principles should be adopted.

a) In severe conditions of exposure, the use of three coats is recommended. Where the limitations imposed by the background will permit, spatterdash treatment can be considered as the first of the three coats if it is applied in such a way as to give a continuous and effective coat. Spatterdash should not, however, be used on no-fines concrete as excessive penetration of surface voids can adversely affect the cellularity of the no-fines concrete and the waterproofing characteristics of the rendering.

b) In moderate and sheltered conditions of exposure, two-coat work is satisfactory.

Reference should be made to clause **31**, which gives more detailed guidance on selection of mixes.

20 Soluble salts in background

Soluble salts, particularly sulphates, may sometimes occur in backgrounds consisting of some types of clay brick or block; in old work they may occur in a wider range of backgrounds, the salts then having been derived from extraneous sources. Whatever the sources, such salts have harmful effects which may lead to cracking and loss of adhesion of the rendering. 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 or into the rendering only in solution. It should be emphasized that although many backgrounds contain soluble salts, problems do not generally arise if the structure is designed and the rendering applied so that water is not able to penetrate into the background.

Where it is impracticable to avoid dampness, e.g. retaining walls, work below damp-proof course at ground level and chimney stacks, rendering should wherever possible be avoided. When, however, rendering is essential on such backgrounds, sulphate-resisting Portland cement should be employed. However, the use of sulphate-resisting renderings is valueless unless the mortar joints in the construction are of similar composition.

An alternative method of rendering over a background which is known to contain sulphates or likely to become impregnated with them is to provide separate support for the rendering. This can be done by applying metal lathing over an isolating membrane.

In all situations, the proper detailing of architectural features is most important in preventing the rendering and background from becoming wet for significant periods. Further information is given in BRE Digest 89[1)].

21 Effects of atmospheric pollution

The accumulation of dirt or other matter deposited from the atmosphere upon the surface of a rendering is in some circumstances inevitable (see also CP 3:Chapter IX). The possibility of such accumulation of deposited matter should be considered, especially in urban and industrial areas. Its effect upon the rendering is two-fold.

a) It may lead to failure of the rendering by introducing destructive substances such as oxides of sulphur and nitrogen which may attack the cementitious 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.

Dirt will find a lodgement on the surface of even a dense and smooth-finished rendering, and although rain may wash a certain 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 clause **19**) 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 rainwater (and with it, the dirt) will give a more uniform discoloration. Proper detailing of copings, over-sailing courses, sills and porches with their associated rainwater drainage, is very important. If, as a result of poor detailing, rainwater is allowed to run down the rendering on a regular path, it will create a poor appearance and could lead to localized erosion and degradation of the rendering.

[1)] Published by the Building Research Establishment (BRE) and available from HMSO.

In areas where atmospheric pollution is severe, it is impossible to prevent discoloration of a rendering, whatever type of finish is adopted; drydash finishes based on natural flint or calcined materials have, however, proved to be relatively self-cleaning. Light-coloured rendering should be avoided. If a surface that will remain free from conspicuous discoloration in such conditions is desired, the use of materials other than a rendering should be considered, unless it is practicable and economical to redecorate the surface at intervals.

22 Corrosion of metals

Metal lathing and stop and movement beads used in external rendering, because of their inevitable exposure to moist conditions, are likely to corrode (rust). The rate of corrosion is very much affected by the severity of the exposure and the prevailing atmospheric conditions and, in particular, by pollution by oxides of sulphur and nitrogen or exposure to marine conditions.

To minimize the risk of corrosion, all metal lathing and fixings and metal beads should consist of stainless steel. However, galvanized components in accordance with clauses **14** and **15** may be used in rendering in the following situations:

a) in moderate and sheltered conditions (see clause **18**) and where the level of atmospheric pollution is low;

b) in renovation work of buildings not exceeding two storeys.

23 Effects of freezing

Breakdown of a rendering by frost action is caused by the expansion on freezing of absorbed water. The risk of frost damage is serious only when the rendering or background remains excessively wet during freezing conditions. Those parts of a building which are subject to severe exposure, such as parapets, chimneys and walls below damp-proof course level, are particularly vulnerable.

In order to obviate problems associated with frost attack, particular attention should be given to the correct detailing of architectural features; these can afford a high degree of protection (see clause **29**).

24 Thermal properties

The rendered finish has little direct effect upon the overall thermal transmittance of a normal external wall, because the conductivity of the rendering material is relatively high and only a thin layer is applied. A rendering may, however, keep a lightweight background sufficiently dry to maintain its low conductivity.

25 Durability

25.1 General

Factors which influence the durability of a rendering are: damage from abrasion and impact; corrosion of embedded metal; poor adhesion; cracking and crazing; rain penetration; problems associated with soluble salts; effects of atmospheric pollution; frost action. Durability of the rendering will also be dependent upon the background, the type of rendering and the method of application.

25.2 The background, its nature and durability

The durability of the various types of background to which renderings may be applied is considered in the relevant codes of practice dealing with those materials or types of structure. The influence of the nature of the background upon the type of rendering recommended is considered in section 4 of this British Standard.

25.3 Type of rendering

The type of rendering and proportions of mix used are of the utmost importance from the point of view of durability. Cement-based renderings, 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 British Standard, there should be no difficulty in obtaining a rendering of adequate durability for any situation.

25.4 The method of application, particularly in relation to the nature of the background

Of the two general methods of application, i.e. laying-on with a trowel 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 good adhesion is difficult to obtain with the laying-on method. Problems may also be experienced when rendering on to backgrounds of high suction (see **36.3**). The good adhesion obtained by a spatterdash or stipple treatment contributes to its efficacy as a means of providing a key on backgrounds with low or high suction.

26 Fire resistance and combustibility

An ordinary external rendering is non-combustible according to the definition given in BS 476-4. A rendering contributes to the fire resistance of a wall but no separate value for that of the rendering can be given; the data for fire resistance of walls with and without rendered finishes are given in the relative codes of practice dealing with various constructions.

27 Resistance to cracking

27.1 Movements of the structural background

Movements of the structural background upon which a rendering is applied may take various forms and may be due to a variety of causes, according to the nature of the background. Shrinkage resulting from the initial drying out of the background is perhaps the most common cause; this applies particularly to backgrounds of cementitious- and calcium-silicate-based materials. Subsequent wetting and drying of the background during the life of the building may also result in dimensional changes; these are generally less than those produced at the time of the initial drying out.

Metal lathing, when fixed to timber or metal framework as a background for rendering, can also give rise to movement problems; these can be associated with drying shrinkage of the timber studding or thermal movement of the metal frames.

27.2 Movement of the rendering

Renderings, in common with many other materials, undergo a shrinkage as they dry out. As the background will usually be rigid, this shrinkage will set up stresses, partly tensile, partly shearing, in the rendering along the plane of adhesion. The tensile stresses tend to cause cracking and the shearing stresses tend to cause failure of adhesion between the rendering and background: both may occur together. If the adhesion is sufficiently strong and uniform the restraints so afforded may offset the whole of the shrinkage stresses. Good adhesion is, therefore, an important factor in the avoidance of cracking. An adequate time, normally a period of several days, should be allowed for each coat to dry out thoroughly before the application of the next in order to minimize the effects of shrinkage.

Another factor affecting adhesion is the relative strength of the background and 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 (see clause **36**).

Renderings may also be affected by thermal movement caused by changes in temperature of the rendering. Except where the rendering has been applied over thermal insulation slabs, which is likely to result in large temperature changes particularly on south facing aspects, such thermal movements are unlikely to be such as to require precautions other than those described in **27.3** to accommodate drying shrinkage.

27.3 Crack control

Some backgrounds are more liable than others to give rise to cracking of the rendering. On such backgrounds precautions should be taken to control the incidence of cracking.

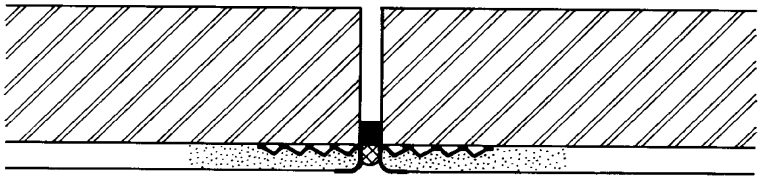
Backgrounds of masonry should be divided into panels to accommodate movement (see BS 5628-3 and BS 6093). A straight joint should be formed in the rendering coincident with the joint in the background (see Figure 4). This may be formed by rendering up to proprietary metal stop beads. The resulting gap should be sealed with a suitable joint sealant.

Where a straight vertical joint occurs in a masonry background, a movement joint should be provided in the rendering.

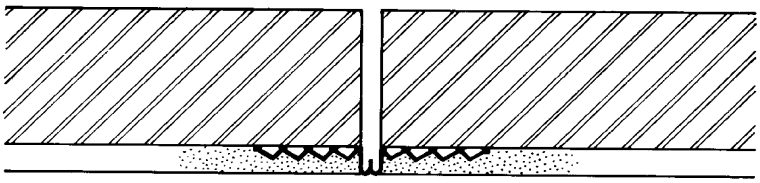
Rendered metal lathing is subject to movement due to temperature or moisture changes. To limit the tendency to crack, the rendering and background should be divided into panels in locations similar to those illustrated in Figure 5. Large uninterrupted areas of rendering on metal lathing should be divided at intervals of approximately 5 m.

Where a rendering is to be continued across dissimilar background materials the possibility of differential movement at their junction should be considered. Any anticipated movement should be accommodated by forming a straight joint right through the rendering in line with the change of background. This can be done by the use of proprietary metal stop or movement beads or by rendering up to a wooden batten which is later removed. The resulting gap should be sealed with a suitable sealant. If differential movement is a remote possibility and it is deemed not necessary or appropriate to provide a joint in the rendering, the effect on the rendering of any movement in the background can be minimized by providing a strip of metal lathing not less than 300 mm wide with an isolating membrane of building paper or polyethylene sheet behind fixed across the junction and embedded in the undercoat of the rendering.

It is recommended that, when galvanized metal stop beads are used, those parts which are exposed or in contact only with the rendering be protected by a suitable coating.



(a) Sealant with backing strip between two stop beads



(b) Proprietary movement beads incorporating cover strip

Figure 4 — Movement joints in rendering aligned to movement joints in background

NOTE Galvanized metal in contact with, but not wholly surrounded by, cement rendering is particularly susceptible to corrosion due to alkali in the cement attacking the zinc locally.

28 Resistance to crazing

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 (see clause **27**). Cement-rich steel-trowelled finishes are particularly liable to craze; on the other hand, leaner mixes with a scraped, textured, or other rough finish are highly resistant to this defect.

The risk of crazing should be minimized by:

a) the use of a properly graded sand, in particular the avoidance of an excessive proportion of a very fine material (see clause **36**);

b) the use of a mix which is relatively lean in cement;

c) the avoidance of overworking, which causes an excess laitance to be drawn to the surface;

d) the avoidance of too rapid drying out of the final coat.

29 Protection afforded by architectural features

29.1 General

The detailing of architectural features can affect the appearance and durability of a rendering and careful consideration should be given to their design.

Where rendering is vulnerable to the penetration of moisture, advantage should be taken of special features to provide protection. Care should be taken that features do not lead to adverse effects upon the rendering or its protective properties.

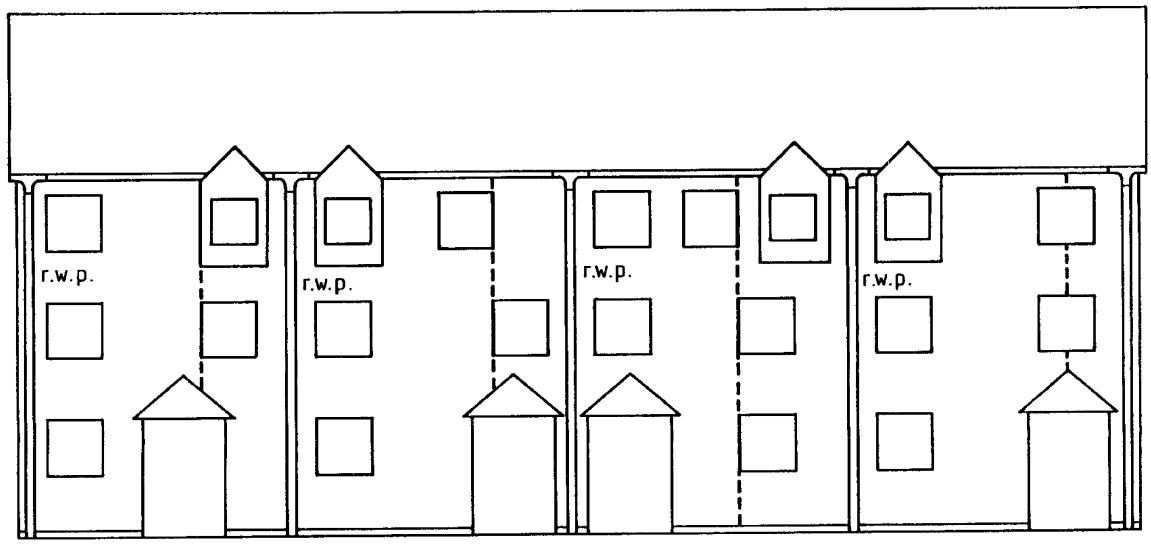
29.2 Parapet and screen walls

Parapet and screen walls are a potential source of weakness with which problems are frequently associated.

Where possible, a parapet wall which is to be rendered should be of cavity construction. It is preferable not to render the backs of walls that are rendered on the face, even when they are constructed of relatively porous materials, because the evaporation of any moisture that may enter the wall through cracks or other weaknesses will be hindered by such rendering (see clause **19**).

Rendering should not be used as a finish for horizontal surfaces exposed to the weather and the practice of carrying rendering over the top of a wall, even if given a considerable weathering slope, is to be deprecated. Walls should be protected by a coping with a damp-proof course immediately beneath it (see Figure 6). The coping should always project beyond the face of the rendering and should have some form of throating or drip on both sides of the wall to throw the water clear. (See guidance on roof edge trims given in **29.3**; see also BS 5642-2 and BS 5628-3. Reference may also be made to BRE Digests 77 and 89[2].)

[2] Published by the Building Research Establishment and available from HMSO.



Key

r.w.p. Rain water pipe

– – – – Position of movement joints in rendering (not movement joints aligned to movement joints in background)

NOTE. The recommended maximum spacing between movement joints is 5 m.

Figure 5 — Elevation showing possible position of movement joints in rendering on metal lathing

29.3 Eaves and verges

Overhanging eaves and verges afford considerable protection to a rendered wall. Their use is strongly recommended, particularly in conditions of severe exposure.

Edge trims should be rigid and clipped and should overhang the rendering. They should be properly sealed at their joints to prevent ingress of water.

29.4 String courses and similar features

When correctly detailed, string courses and similar features can provide protection to rendering and should be formed of materials such as stone, brick or concrete. Such features can form part of the rendered finish (see clause **35**). The top surfaces of projections should always be sloped to drain water away from the wall or into a suitably placed gutter. They should be protected by flashings; such protection is essential when the slope is shallow or is formed in the rendering. All projections should have an efficient throat or drip on the underside (see Figure 7).

29.5 Sills

Sills should be made of a material of low permeability; they should project beyond the face of the rendering and should extend beyond the line of the reveals. Sills should have an efficient throat or drip on the underside and should be designed to prevent water running onto the wall below, or into the jambs. Sills should be always detailed with a damp-proof course under. Tile sills should be two courses thick, the courses to be laid to broken joint. The formation of sills to windows or other openings by rendering is not recommended. (See BS 5642-2, BS 6510 and Figure 7.)

29.6 Soffits and reveals

The rendering should be finished immediately above an opening in such a way as to prevent water running back on the soffit, i.e. with a bellcast or drip throating. Projecting features should have an efficient throat or drip.

Reveals should be rendered and finished in the same way as the walls. A groove should be left in the rendering above and at the sides of openings to accommodate a sealant.

29.7 Treatment at base of walls

Rendering below the damp-proof course at ground level should be avoided. Where rendering is used for protection against weather and is not carried down to ground level, it should be finished immediately above the damp-proof course in such a way as to throw water clear of the exposed wall below, i.e. with a bellcast (see Figure 8).

A rendering should not be carried across the exposed edge of the horizontal damp-proof course at any level without a break, because it may transmit moisture past the damp-proof course and make the latter ineffective; also, movements of the building on the damp-proof course may cause unsightly cracking. Where it is necessary to have the rendering below as well as above the damp-proof course, the latter should be designed to project through the rendering to act as a flashing. If this is not practicable, the rendering may be cut through to the face of the damp-proof course immediately after application so that a clean break is formed. Care should be taken that the edges of the cut are properly weathered.

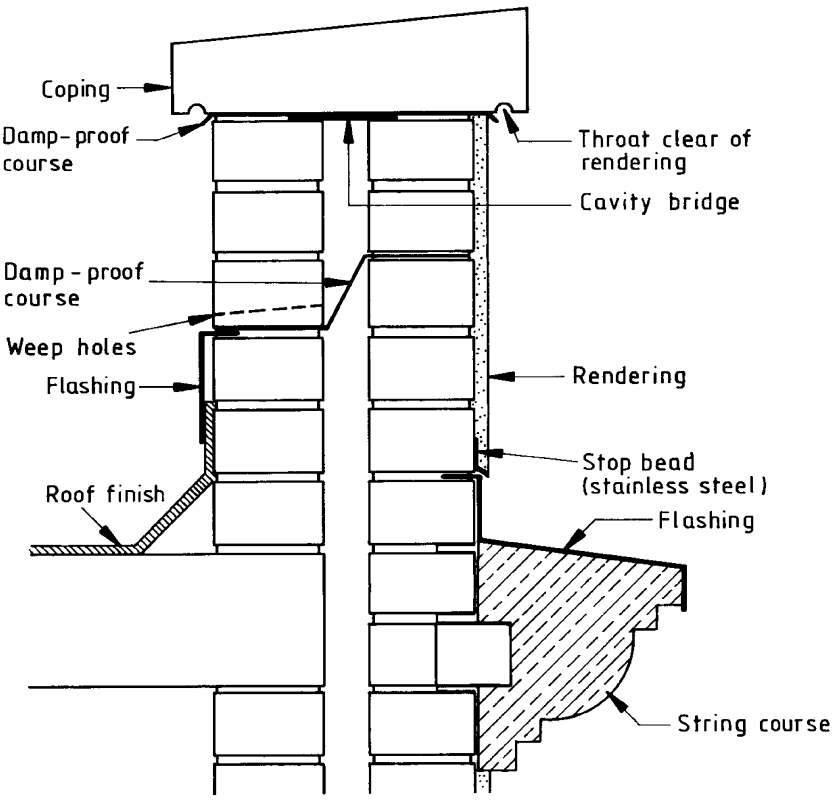
30 Rendering to chimney stacks

Chimney stacks, because of their exposed position, are liable to remain wet for long periods and are, therefore, particularly susceptible to sulphate action where bricks containing significant amounts of soluble salts are used for their construction (see clause **20**). Chimney stacks should only be rendered where the bricks contain little or no sulphates; even then, it would be a sensible precaution to use sulphate-resisting cement in both the brickwork mortar and in the rendering mix.

In older buildings, with flues that are unlined, sulphates derived from condensed flue gases can increase the risk of sulphate attack. Such chimney stacks should not be rendered unless a suitable lining is provided in the flue.

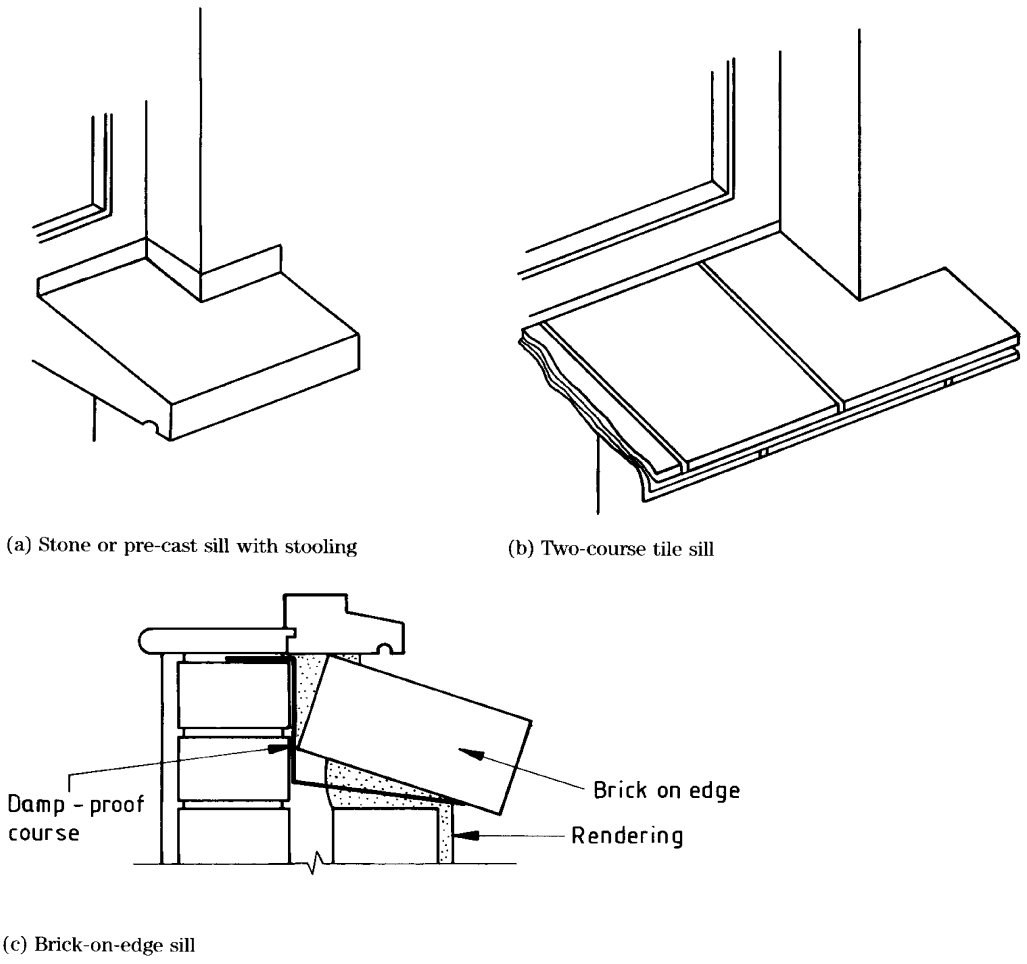
Irrespective of the type of background, a spatterdash treatment should be applied and the rendering should be of a type suitable for severe exposure conditions (see Table 1, Table 2 and Table 3).

Chimney stacks should have projecting and throated cappings. The rendering should not bridge damp-proof courses. (BS 6461-1 deals with the construction of masonry chimneys.)



NOTE. Stepped damp-proof course drains away from rendered leaf.

Figure 6 — Parapet and string course details

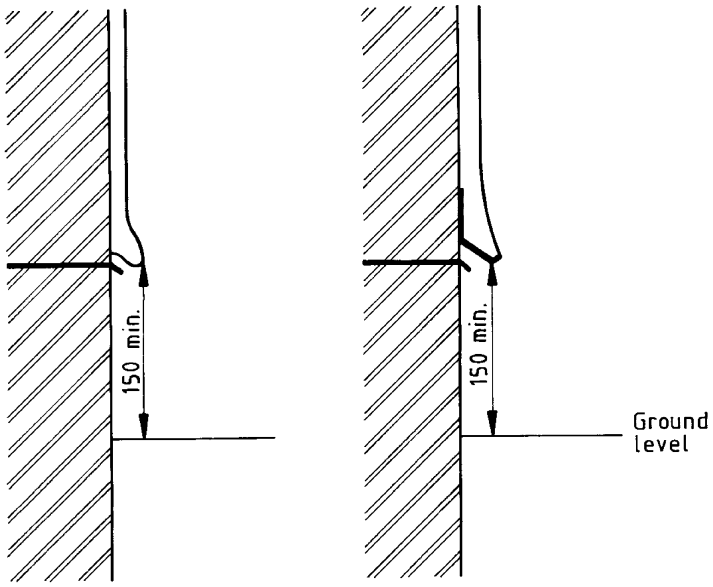


(a) Stone or pre-cast sill with stooling

(b) Two-course tile sill

(c) Brick-on-edge sill

Figure 7 — Types of sill



(a) Bellcast formed in rendering (b) Use of external rendering stop

NOTE. All dimensions are in millimetres.

Figure 8 — Alternative details at base of walls

31 Mixes

31.1 General

The compositions of mix designations I to V are given in Table 1. Mixes recommended for use in different combinations of circumstances are given in Table 1, Table 2 and Table 3.

The mix for each successive coat should never be richer in cement than the mix used for the coat to which it is applied.

31.2 Designation I mixes

Designation I mixes produce strong, relatively impervious renderings with high drying shrinkage and consequently high susceptibility to cracking. Their use should be restricted to strong backgrounds such as first coats on metal lathing and abrasion-resistant applications such as plinths.

31.3 Designations II, III and IV mixes

Designations II, III and IV mixes are likely to provide satisfactory results in most types of rendered finish and under most conditions. They are more permeable than designation I mixes and have a lower drying shrinkage. Their strength is adequate for the conditions laid down in Table 2 and Table 3. Mix designations III and IV in particular are less liable to cracking and crazing. The mixes lower in cement content may not be sufficiently hard to deter vandals or to withstand severe abrasion.

31.4 Designation V mixes

Designation V mixes are suitable for weak backgrounds in sheltered locations and for remedial work to weak lime-based renderings.

31.5 Spatterdash mixes

Spatterdash mixes are described in **38.2.2**.

31.6 Machine- and trowel-applied decorative finishes

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

31.7 Mixes containing polymer dispersions

Polymer dispersions may be used in rendering mixes to improve bond strength, resistance to rain penetration and durability. They should be used in accordance with the manufacturer's instructions.

31.8 Mixes containing fibres

Fibres included in the mix improve the toughness of the rendering. They restrict the width of cracks rather than preventing cracking.

NOTE Glass fibres produced at present tend to reduce in strength with time in damp alkaline conditions.

31.9 Special mixes for external insulation

Proprietary cement-based mortars containing polymers or reinforced with fibres and meshes can be used for direct application to insulation materials or on to lathing fixed over insulation materials.

32 Number and thickness of coats

32.1 General

A rendering normally comprises at least two layers, namely, an undercoat and a final coat.

Metal lathing should have two undercoats. Two undercoats should also be used where it is desired to give improved resistance to rain penetration.

Normally, the thickness of the rendering should be not less than 20 mm for three-coat work and 16 mm for two-coat work.

32.2 Spatterdash, stipple and adhesive slurry

Spatterdash, stipple or adhesive slurry should be used on dense smooth backgrounds to provide a key for the undercoat (see **38.2.2** and **38.2.3**). On absorbent backgrounds these materials should be used to reduce or to even out varying suctions. Spatterdash and stipple give a rough textured surface and may be up to 5 mm thick overall.

32.3 Dubbing-out

If dubbing-out is needed, it should be done well in advance of the application of the first undercoat and should be allowed to harden for several days before the undercoat is applied. The mortar for dubbing-out should be the same mix as that used for the first undercoat and care should be taken to ensure that the dubbing-out is mainly thicker than the undercoat which is to follow.

Except for small localized areas, mortar should not be applied any thicker than 16 mm in any one coat. The surface should be deeply scored to relieve shrinkage stresses and improve the key for subsequent coats. In quick-drying conditions, it may be necessary to wet down the dubbing-out before allowing it to dry out. If further dubbing-out is needed before an undercoat of sensibly uniform thickness can be applied, it will usually be necessary to provide additional support for this layer in the form of expanded metal lathing or welded wire mesh, mechanically fixed to the wall.

32.4 Undercoats

An undercoat is the main component in a rendering in resisting rain penetration. Where wind-driven rain is severe, two undercoats should be used. The undercoat should provide a flat surface to receive the final coat.

Ideally the undercoat should be about 12 mm thick but it will have to accommodate slight unevenness in the alignment of the wall and so will vary in thickness when the wall is not flat. The undercoat should be not less than 8 mm nor more than 12 mm thick, except in localized areas where the maximum should be 16 mm.

When two undercoats of the same mix are specified, the first undercoat should be thicker than the second, e.g. 10 mm and 8 mm respectively. Alternatively, if a slightly richer mix is used for the first undercoat, the two coats may be the same thickness.

Undercoats of adequate thickness minimize the effect of variations in the suction of the background and the likelihood of joints in masonry "grinning" through the final coat.

32.5 Final coat

The thickness of the final coat is largely determined by the size of coarse particles in the sand. Given this constraint, the final coat should be applied in as thin a layer as possible. With sands up to 3 mm, the final coat can usually be finished about 6 mm thick.

The final coat should be of uniform thickness.

33 Types of finish

33.1 General

In general, textured finishes are less liable to crack and craze than a plain finish; also, any cracks that do develop are less likely to be obtrusive. Textured finishes are easier to bring to a uniform appearance; this is an important consideration when the rendering is coloured. Although offering more lodgement for dirt, a rough texture tends to even out any discoloration which makes the dirt less apparent than with smoother finishes. Also, the distribution of the flow of rain water over a textured surface reduces the risk of penetration through the rendering.

The finishes for external renderings fall into two broad categories, trowel finishes (see **33.2**) and thrown finishes (see **33.3**).

33.2 Trowel finishes

33.2.1 *Plain finishes*

Plain finishes should be achieved by using a wooden float; this type of finish requires a high standard of workmanship to minimize the risk of crazing and irregular discoloration. A steel trowel should not be used for finishing an external rendering. A variation in finish can be obtained by using a felt-covered float or similar tool.

33.2.2 *Scraped or textured finish*

Textured finishes should be achieved by working the surface of the freshly-applied final coat with a trowel or other hand tool or, alternatively, a textured finish can be applied direct from the nozzle of a rendering machine. Scraped finishes should be obtained by allowing the final coat to harden for several hours and then scraping it with a suitable tool.

33.3 Thrown finishes

33.3.1 *General*

Under severe conditions of exposure, thrown finishes are generally more satisfactory than trowel-applied finishes in respect of weather-resistance, durability and resistance to cracking and crazing. Roughcast and drydash finishes are normally used on strong backgrounds. Mix properties will need to be modified for use on weaker backgrounds (see Table 2 and Table 3).

33.3.2 *Roughcast*

A roughcast finish should be achieved by throwing on the final coat of rendering as a wet mix and leaving it un-trowelled. The "roughness" is determined by the shape and size of the coarse aggregate in the mix.

33.3.3 *Drydash*

A drydash finish should be produced by throwing crushed rock chippings or pebbles on to a freshly-applied mortar layer (buttercoat) using a small shovel or scoop and leaving it exposed.

33.3.4 *Machine-applied*

Power- or hand-operated machines can be used to apply the rendering.

34 Colour and texture

34.1 General

The natural colour of a rendering which is determined by that of the cement, fine aggregate and water content of the mix may be modified by the addition of pigments. Alternatively, the use of a suitable paint to obtain the desired colour for the rendering may be used (see **52.3**).

Consideration should also be given to a textured surface for improved appearance (see **33.1**).

When light colours are required, it is preferable to use a white Portland cement: other cements have a deadening affect upon most colours. Lime in a mix will lighten the colour. Some admixtures may produce a darker colour. Only the final coat of render need be coloured and this should be done by one of the following means.

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

b) *Using a pigment* (see clause **8**). It is not easy to achieve consistency when adding pigments to mixes on site. It is recommended that coloured ready-mix lime:sand for mortar, a ready to-use retarded mortar or a dry, bagged pigmented mortar be used. Such mixes have advantages in the control and uniformity of colour and texture available. The supplier's instructions should be followed. A sufficient quantity to complete defined panels of work should be obtained at one time. The material not being used should be kept covered to protect it from the weather.

It is difficult to achieve a completely uniform colour. A difference in suction of the background is one of the main reasons for colour variations. It is even more difficult with darker colours which are liable to lighten through formation of a white film of calcium carbonate on the surface known as "lime bloom". The incidence of lime bloom depends mainly on the weather conditions at the time of finishing the surface and the subsequent drying. It may be exacerbated by rendering when the background is very wet.

Variations in colour can also be caused by the sequence of construction. It is advisable to avoid random panel work.

The effects of weathering, atmospheric pollution and discoloration by sooty deposit should be taken into account. The recommendations of clause **21** are particularly important with coloured finishes.

34.2 Solar radiation

It should be noted that darker coloured finishes on surfaces receiving solar radiation will be subjected to a greater range of temperatures than lighter coloured finishes and are more liable to be affected by thermal movement. Over insulating materials, rendering should be lighter coloured unless on north facing or shaded elevations.

35 Ornamentation in relief

35.1 General

Apart from the various special finishes, ornamentation can be achieved as part of rendering operations. It may take any of the forms described in **35.2** and **35.3**.

35.2 Moulding and modelling

Great care should be exercised in the use of moulding and modelling in external rendering to ensure maximum key to the background and adequate strength and durability of the material in relation to the sharpness and the form of the relief. In general, a stronger mix than for plain surfaces should be used. Any moulded or modelled feature having a thickness over the background that is substantially greater than 40 mm in any part should be given positive support, e.g. by inserting dowels of stainless steel or non-ferrous metal or tiles on edge into the background or by fixing metal lathing on firring.

In designing such ornamentation, attention should be paid to the protection of horizontal surfaces or other projecting features as discussed in **29.4**.

35.3 Sgraffito

The pattern in sgraffito work is obtained by applying several thin coats of rendering of different colours and, before they are hard, scraping down to the coat of appropriate colour in the various parts of the design. The design itself is usually pricked out on a paper pattern and pounced on to the surface to be decorated. Any preparation of the background, including spatterdash if required, and the application of the first undercoat, should follow the recommendations made elsewhere in this British Standard. The first undercoat should be allowed to harden before applying the various coloured coats.

The mixes to be used for the various coloured coats will be especially designed according to the requirements of the artist in relation to both colour and texture, but the general principles of avoiding excessively strong mixes and of making successive coats not stronger or thicker than previous coats apply. Required colours may be obtained as described in clause **34**. The sand used should be especially chosen or should be screened according to the texture required. The presence of very coarse particles will prevent clean and sharp lines in the pattern. The more detailed the design, the finer the sand will generally need to be.

The various coloured coats need only cover areas slightly greater than the parts which will be exposed in the design. Different coloured mixes may be used in different parts of the same coat, or several thin coats may be used, each 3 mm or 4 mm thick, depending upon the number of colours required. The final coat should be of the colour required for the final finish of the wall or other surface and will usually be treated to give the required finish before scraping the design. The scraping should be completed before the rendering has hardened and the work should be protected against rain until hard.

Table 1 — Mixes suitable for rendering (see clause **31**)

Mix designation	Mix proportions by volume based on damp sand				
	Cement:lime:sand[a]	Cement:ready-mixed lime:sand[a]		Cement:sand[a] (using plasticizer)	Masonry cement:sand[a]
		Ready-mixed lime:sand	Cement:ready-mixed material		
I	1 : ¼ : 3	1 : 12	1 : 3	—	—
II	1 : ½ : 4 to 4½	1 : 9	1 : 4 to 4½	1 : 3 to 4	1 : 2½ to 3½
III	1 : 1 : 5 to 6	1 : 6	1 : 5 to 6	1 : 5 to 6	1 : 4 to 5
IV	1 : 2 : 8 to 9	1 : 4½	1 : 8 to 9	1 : 7 to 8	1 : 5½ to 6½
V	1 : 3 : 10 to 12	1 : 4	1 : 10 to 12	—	—

NOTE In special circumstances, e.g. where soluble salts in the background are likely to cause problems, mixes based on sulphate-resisting Portland cement should be employed.

[a] With fine or poorly graded sands, the lower volume of sand should be used.

Table 2 — Severe exposure: recommended rendering specifications (see note 1)

Background (see section 4)	First undercoat		Second undercoat[a]		Final coat (see **32.5** and note 2)	
	Designation (see Table 1)	Thickness (see **32.4**)	Designation (see Table 1)	Thickness (see **32.4**)	Type	Mix proportions by volume[b] or designation (see Table 1)
		mm		mm		
Strong to moderate	II	8 to 12	II	6 to 10	Roughcast	1 : ½ : 3 : 1½
					Buttercoat for drydash Tyrolean	II
Metal lathing	I	3 to 6	II	10 to 14	Roughcast	1 : ½ : 3 : 1½
					Buttercoat for drydash Tyrolean	II
Moderate to weak	III	8 to 12	III	6 to 10	Roughcast	1 : 1 : 4 : 2
					Buttercoat for drydash	III
					Tyrolean	II

NOTE 1 The nominal overall thickness (excluding texture) is not normally less than 20 mm.

NOTE 2 For severe exposure, it is preferred that the finish be thrown or rough textured.

[a] For severe exposure, the use of two undercoats is preferred.

[b] Cement:lime:sand:coarse aggregate.

Table 3 — Moderate and sheltered exposure: recommended rendering specifications (see note)

Background (see section 4)	**Undercoat**[a]		**Final coat** (see **32.5**)		
	Designation (see Table 1)	**Thickness** (see **32.4**)	**Finish**	**Type**	**Mix proportions by volume**[b] **or designation** (see Table 1)
		mm			
Strong to moderate	II	8 to 12	Thrown	Roughcast	1 : 1 : 3 : 2
				Buttercoat for drydash	III
				Tyrolean	II
	III	8 to 12	Trowel applied	Woodfloat Scraped Patterned Tooled	IV
Moderate to weak	III	8 to 12	Thrown	Roughcast	1 : 1 : 3 : 2
				Buttercoat for drydash	III
				Tyrolean	II
	IV	8 to 12	Trowel applied	Woodfloat Scraped Patterned Tooled	IV
Weak (in sheltered positions only)	IV or V	8 to 12	Trowel applied	Woodfloat Patterned	V
Metal lathing	Two undercoats as for severe exposure (see Table 2)		Thrown	Roughcast	1 : 1 : 3 : 2
				Buttercoat for drydash	III
				Tyrolean	II
			Trowel applied	Woodfloat Scraped Patterned Tooled	IV

NOTE The nominal overall thickness (excluding texture) is not normally less than 16 mm.

[a] For moderate and sheltered exposure, the use of one undercoat is acceptable for all backgrounds except metal lathing.

[b] Cement:lime:sand:coarse aggregate.

Section 4. Backgrounds

36 Characteristics

36.1 General

Renderings are applied to backgrounds specifically designed and erected to receive them. Alternatively, they 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 considered in **36.2** to **36.6**.

36.2 Strength

The background should adequately support and restrain movement of the rendering. Masonry backgrounds, including the mortar joints, should be no weaker than the rendering and should preferably be stronger. On weak backgrounds, rendering mixes should be restricted to designations III, IV or V.

36.3 Suction

Adhesion of a rendering is determined to a great extent by the suction of the background, especially where there is no adequate key. Both high suction, which removes water quickly, and low suction tend to impair the development of a good bond. It should be appreciated that the suction of a background can be affected significantly by its moisture content at any given time.

36.4 Key

Rendering mortar penetrating, locking into holes or surrounding pinnacles and strands in the background assists adhesion. The keys may be provided naturally or artificially. Keys should be spaced regularly over the whole surface and should be undercut or wedge-shaped. Examples of backgrounds providing a key are as follows:

a) no-fines concrete;

b) lathing;

c) wire meshes;

d) open textured or keyed masonry units;

e) raked joints;

f) spatterdash and stipple treatments.

36.5 Joints and cracks

It should be appreciated that backgrounds with existing cracks cannot be rendered directly without a risk of such cracks forming in the finish. Other backgrounds, e.g. walls with insufficient movement joints or with junctions between dissimilar materials also have the potential to crack after they have been rendered.

36.6 Durability

36.6.1 *General*

The durability of the masonry background should be established by reference to BS 5628-3.

36.6.2 *Frost*

Renderings slightly improve the frost resistance of masonry material. The background itself should be resistant to frost damage in the intended environment. Masonry units have variable properties and the frost resistance of the worst in the batch should be taken as a guide because the failure of only a few units in a rendered wall can lead to an unacceptable appearance and progressive deterioration. Classifications of frost resistance for clay bricks are given in BS 3921.

36.6.3 *Soluble salts*

If the background contains soluble salts (especially sulphates) and remains wet for prolonged periods, the rendering may deteriorate due to chemical action between the salt and the cement in the rendering or in the mortar joints. Damage may also result during crystallization of soluble salts. The limits for soluble salts given in BS 3921 provide a useful guide for clay bricks. Calcium silicate bricks contain negligible soluble salts.

36.6.4 *Corrosion*

Backgrounds containing metal other than stainless or galvanized steel as reinforcement may deteriorate by rusting and spalling. A covering of rendering may delay the corrosion of steel but the delay is only likely to be marginal unless the rendering is especially formulated to be rich in cement, dense and of low permeability.

37 Types

Existing walls or materials to be rendered should be examined for contamination, deterioration and a subjective assessment made of the roughness, suction and strength. Recommendations for various types of new background are given in Table 4. Recommendations for existing and failed backgrounds, which may present problems, are given in Table 5.

NOTE The ideal background is an inherently durable and moderately strong walling with a rough or keyed surface, medium suction, and no contamination from oil, soluble salts, loose materials, surface growths or coatings.

Table 4 — Summary of precautions for rendering on to various types of new backgrounds

Background	Characteristics considered	Recommendations	Clause reference
Clay bricks			**38.1**, **38.2** and **38.3**
All types	Suction and key	Preparatory treatment required for backgrounds with low suction and poor key	
	Frost resistance	Check that bricks are correct designation	
	Expansion	Continue movement joints through rendering	
Additionally			
[a]MN and [a]FN	Soluble salts	Use sulphate-resisting Portland cement	
[a]OL and [a]ON	Frost and soluble salts	Cover with lathing before rendering	**38.7**
Concrete and calcium silicate			**38.1**, **38.2**, **38.3**, **38.4** and **38.5**
All types[b]	Suction and key	Preparatory treatment required for backgrounds with low or high suction and for poor key	
	Drying shrinkage	Continue movement joints through rendering	
	Strength	Use weak mixes on low strength materials	
No-fines concrete	Rain penetration	Rendering needed to prevent rain penetration	**38.5**
Stone			**38.1** and **38.2**
Fair faced	Suction and key	Preparatory treatment required if low suction and poor key	
Rubble	Key	Repoint and leave pointing rough or scratched	
Metal lathing			**38.7**
	Movement	Provide movement joints	
	Stability	Fix firmly, use rich undercoat, allow to cure and dry	
	Corrosion	Ensure corrosion resistance sufficient for purpose	
Expanded plastics boards			**38.7.5**
	Low strength Low suction Moisture movement	Use thin reinforced polymer modified rendering or metal lathing as support for cement:sand rendering	
Mixed materials			**27.3** and **38.1**
	Differential movement	Use mix recommended for weaker background	
	Differential adhesion	Form movement joint or span junction with reinforcement on isolating layer	

[a] Abbreviations: MN : Moderate frost resistance, normal soluble salt content clay bricks;
FN : Frost resistant, normal soluble salt content clay bricks;
OL : Not frost resistant, low soluble salt content clay bricks;
ON : Not frost resistant, normal soluble salt content clay bricks.

[b] For example, in-situ concrete, precast concrete units, concrete blocks and bricks, calcium silicate bricks.

Table 5 — Summary of recommendations for rendering on to contaminated or deteriorated existing backgrounds

Problem	Recommendations	Clause reference
Cracks:		
— in background	Determine cause of cracks, remove rendering, repair, isolate and reinforce new rendering as appropriate	**50.3**
— in rendering	Inspect for hollowness, cut out hollow areas, widen and fill all but very fine cracks and decorate	**50.2**
Hollowness	Repair any defective details, remove hollow rendering, patch the rendering, re-decorate if necessary	**51.2**
Spalled backgrounds:		
— bricks	Cut out and replace with new bricks or layers of mortar before rendering	**32.3** and **51.3**
— reinforced concrete	Cut back to expose any corroded reinforcement, clean and protect, embed in rich mortar	**38.5**
Eroding surfaces	Abrasive blast to sound material and use a stipple coat or cover with metal lathing before rendering	**38.1**
Painted surfaces	Abrasive blast and if necessary bonding treatment, or cover with metal lathing	**38.1**
Salt contamination	Correct any faults, dry brush or abrade off any salts, then use bonding treatment	**20**
Oil splashes	Remove all traces of oil or isolate rendering	**38**
Organic growth	Kill with toxic wash and remove by brushing	**38**

38 Preparation of background

38.1 General

The background should be assessed for its suitability to receive and to provide permanent support for the rendering. On new work, designed to be rendered, the removal of all dust and any contamination such as splashes of oil or plaster may be all that is needed.

Walls that have previously been plastered or painted should not be rendered unless all traces of these materials are first removed. This can be done by abrasive blasting, although this may not necessarily provide a good key for rendering. Alternatively, a rendering should be applied over expanded metal lathing firmly attached to the wall. Metal lathing should always be used where walls have been treated with a water-proofing solution and where the surface is too weak and friable to support a rendering.

Any organic growth on the wall should be killed with a toxic wash and, after a suitable interval, the dead, dry material should be removed by brushing. Advice on the control of organic growth is given in BRE Digest 139[3)].

Before any rendering is begun, all cutting back and drilling for fixings for brackets and supports for services should be completed. Plugs should be fixed at this stage to project at least to the face of the finished work (see Figure 1). Where brackets are fixed adjoining a movement joint, care should be taken to ensure that initial and subsequent fixings are made only on one side of the joint.

To provide an adequate key, the surface to be rendered should have two properties:

a) absorption or suction;

b) a texture or roughness.

Renderings normally adhere to the wall by a combination of suction and texture, but where suction is lacking, as on no-fines concrete or expanded metal, they rely solely on the surface texture.

[3)] Published by the Building Research Establishment (BRE) and available from HMSO.

The amount of suction may be judged by splashing the clean wall with water. If the water is readily absorbed the wall should be wetted before the rendering is applied; this will limit the reduction in workability resulting from a loss of water by absorption into the background. High suction can also deprive the rendering of water needed for its hardening.

Conversely, it is important for the wall not to be too wet. Some suction is necessary so that a good bond develops between the rendering and the background. Walls that have recently been exposed to heavy rain should be allowed to dry for 1 day to 2 days before rendering is attempted.

38.2 Preparatory treatments

38.2.1 ***General***

Smooth, dense surfaces can be provided with an effective textured key by applying a spatterdash or a stipple. Alternatively, an adhesive slurry can be used. The choice between spatterdash and stipple depends to some extent upon the absorbency of the background: some suction is needed to retain a spatterdash treatment whereas a stipple or an adhesive slurry can be applied where suction is negligible. These same preparatory treatments are also useful when rendering on to high-suction backgrounds in order to prevent the absorption of too much water from the rendering.

38.2.2 ***Spatterdash and stipple***

The mix for spatterdash should consist of 1 part cement and 1½ parts to 2 parts by volume of clean coarse sand mixed to a thick creamy consistency with water; a bonding agent such as a styrene-butadiene rubber (SBR) latex, an ethyl vinyl acetate (EVA) emulsion or an acrylic emulsion may be incorporated. The mixture should be kept well stirred to prevent it segregating. The mix should be applied by dashing it on to the wall to give complete coverage with a rough texture about 3 mm thick. It should be left untrowelled. The surface should be dampened periodically over 1 day to 2 days until the spatterdash has hardened and then should be allowed to dry. It should be checked to ensure that it is firmly bonded to the background before the undercoat is applied.

The mix for stipple should be the same as that for spatterdash but a bonding agent should always be used. The mix should be scrubbed vigorously into the clean surface of the wall with a bannister brush and then immediately stippled with a well-loaded brush to produce a deep close-textured key over the whole surface. Curing and checking should be the same as for spatterdash.

38.2.3 ***Adhesive slurry***

Certain SBR latices, acrylic polymers or EVA emulsions may be used for bonding renderings. They should be mixed with cement or cement-and-sand to form a creamy slurry and should be scrubbed on to the wall immediately prior to rendering. The manufacturer's instructions for use should be closely observed. With this method, it is essential that the rendering be applied straightaway whilst the slurry is still wet, otherwise it will form an effective debonding layer.

38.3 Brickwork

Brick walls should be built with raked joints to provide a key for the rendering. The joints should be raked back squarely 10 mm to 12 mm deep. Keyed bricks do not need to have raked joints.

With old brickwork, the joints should be raked out if the mortar is fairly weak, but if it is as hard as the bricks it will be easier to provide a key with a spatterdash or stipple, or to use an adhesive slurry or, alternatively, to use metal lathing.

38.4 Blockwork

Most concrete blocks have surfaces which afford a key to receive rendering. Blocks with smooth dense surfaces should be given a preparatory treatment in the same way as concrete or brickwork. High suction may be experienced with some backgrounds under dry conditions. Where this occurs it should be overcome by wetting the wall before the rendering is applied to reduce the suction. The wall should not be soaked with water but surface wetting may be necessary, especially during or following dry weather, to prevent the undercoat from drying too rapidly. If suction still proves to be a problem, a stipple coat or spatterdash should be used.

38.5 Concrete

Dense concrete, because of its low absorbency, will not afford a satisfactory bond for a rendering unless it is textured to give an adequate key. The texture should be either indented in the surface of the concrete or applied subsequently.

With new work, the most straightforward method is to produce a horizontally-ribbed surface by casting the concrete against rubber or composition linings attached to the formwork. Alternatively, a coating of a surface-retarder applied to the formwork will delay the hardening of the mortar in contact with the form face and enable it to be removed later. As soon as the formwork is struck, the face of the concrete should be brushed to expose the aggregate to a depth of 2 mm to 3 mm. The surface should then be washed to remove all traces of retarder and loose material.

Hardened concrete can be textured by tooling with a needle-gun or by bush-hammering. The needle-gun should be used only on low-strength concrete and structural concrete up to about 3 days old. Abrasive blasting is also effective with concretes of this age. Bush-hammering should not be carried out on concrete less than 2 weeks old. With reinforced concrete, it may be necessary to obtain approval before any tooling is done because of its effect on cover. Spatterdash, stipple and adhesive slurry are acceptable alternative ways of providing a key.

No-fines concrete should always be rendered to prevent rain penetration, but no surface treatment is necessary as its surface provides a satisfactory key.

38.6 Insulation boards

A wide variety of types of insulating boards is available, including mineral wool, polystyrene, polyisocyanurate, polyurethane, foamed glass and phenolic resins.

Insulation boards should be fixed securely and rigidly, with tightly butting joints, to form a flat surface. Generally, the boards should be overlaid with reinforcement as described in **38.7.5**.

Proprietary systems are available using polymer-modified cement-based rendering. For these, the manufacturer's recommendation should be followed.

38.7 Reinforcement

38.7.1 *General*

Exposure conditions should be taken into account when selecting the type and grade of metal reinforcement to be used. For severe conditions metal lathing should be austenitic stainless steel to Grade 304 of BS 1449-2.

Expanded metal should be fixed with the long dimension of the mesh at right angles to the supports. If they are more than 350 mm apart, the weight of the mesh should be increased above that normally used in order to give sufficient rigidity. Ribbed lath and some welded wire mesh have greater rigidity and the spacing of supports can be up to 600 mm.

For fixing, lapping and tying sides and ends of metal lathing, reference should be made to BS 8000-10. Fixing methods vary for different types of lathing and the manufacturer's instructions should be followed.

When rendering is applied to a solid background and proper bond is obtained, considerable restraint against differential movement is achieved; however, movement joints should be provided at appropriate intervals and, in any case, should be provided where there is a joint in the background. Rendering on metal lathing fixed to timber or steel framed construction can be subject to movement of the background and special provisions for crack control may be necessary (see clause **27**).

38.7.2 *Reinforcement over smooth concrete, stone, painted brickwork and similar backgrounds*

Lathing should be fixed to the background with a space behind to allow the rendering to key to it and at spacings recommended by the manufacturers for the type and gauge of lathing employed.

Methods of fixing metal lathing should be as follows:

a) nailing into suitable cast-in blocks with washers over the lathing;

b) screwing into plugs in drilled holes, with washers over the lathing;

c) expanded type screw fixings with washers over the lathing;

d) wiring to prefixed channel sections, angles or cleats, or to screwed fixings;

e) battening out using preserved timber battens with the lath fixed as described in **38.7.3** and the breather paper omitted.

38.7.3 *Reinforcement over timber-framed construction*

Before fixing lathing, the studding should be overlaid with a water-resistant breather membrane complying with BS 4016. The types of metal lathing described in clause **14** of this standard should be employed, fixed to a span 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. The lathing should be fixed with 38 mm long, 7 mm diameter head clout nails or 32 mm × 2 mm staples at approximately 100 mm centres (10 per linear metre).

If the timber framing is sheathed with rigid boarding, additional vertical battens are required; these should be of preserved timber and should be fixed vertically (see clause **16**). A breather membrane should be fixed over them. Lathing should then be fixed at spacings recommended by the manufacturer for the type and gauge of lathing employed.

Behind the lathing, there should be a clear drained cavity not less than 40 mm wide for an unbacked lathing and not less than 20 mm wide for lathing backed, for example, by a breather membrane.

38.7.4 ***Reinforcement over metal framed construction***

The types of metal lathing described in clause **14** should be employed. Fixing should be by wiring on with 1.2 mm tying wire at approximately 100 mm centres (10 per linear metre) or 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 stainless steel or 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 **15.4**.

38.7.5 ***Reinforcement over insulation***

The method of application should be either of the following although they are not exclusive. Both involve the use of a reinforcement mesh as a carrier for the rendering.

a) Metal lathing should be fixed through to the background and supported away from the surface of the insulation so that rendering can be trowelled through and behind the lathing. This spacing can be provided by any of the following means:

1) using lathing incorporating spacers, e.g. ribbed lathing;

2) fixing to battens or firrings as in **38.7.2** and **38.7.3**;

3) using a pre-coated heavily textured insulation;

4) using fixings with spacers.

Fixings should be either as described in **38.7.2** and **38.7.3** or special insulation pins which are usually made from stainless steel or plastics.

b) A non-metallic mesh should be embedded in a coat of polymer-modified cement-based rendering which has been applied to the insulating board. A heavy duty reinforcement should be used to provide increased impact resistance at ground level and other vulnerable areas. Where heavy duty mesh is used, the thickness of the bedding coat may need to be increased. Additional strips of the mesh should be used in areas of increased stress such as at the corners of door and window openings.

Although the use of polymers in cementitious-based mixes can reduce the amount of shrinkage cracking occurring, consideration should still be given to the need to provide movement joints in large uninterrupted areas.

Section 5. Work on site

39 Storage of materials

39.1 Lime, cement and pre-mixed dry bagged materials

Hydrated lime, cement and pre-mixed dry bagged materials should be stored off the ground, under cover and away from damp surfaces, in such a manner as to allow the bags to be used in rotation in order of delivery.

39.2 Ready-mixed lime : sand for mortar

Ready-mixed lime : sand for mortar should be tipped on to a clean sealed banker board with a sealed base and should be covered when not in use. Covering over is particularly important when coloured mortars are being used because rain and weathering may wash out some of the pigment or other fine material and lead to variation in colour.

39.3 Ready-to-use cement : lime : sand or cement : sand

Retarded ready-to-use mortars should be stored in containers approved by the mortar supplier. The containers should be covered to protect from rain and water loss due to the effects of sun and wind. In cold weather, a protected environment should be provided to ensure the mortar does not freeze. The mortar should not be used after the initial set has commenced.

39.4 Aggregates

Aggregates should be stored separately, according to type, on clean hard dry ground that is well drained and protected from contamination by soil, falling leaves or other harmful materials.

Special aggregates should be stored separately away from all others and should be obtained in sufficient quantity at one time to enable material of the approved colour to be used for the whole of the work.

39.5 Metal lathing and firring battens

Metal lathing and firring battens should be stacked off the ground under cover and away from damp surfaces.

40 Scaffolding

Independent scaffolding should be used to avoid the subsequent making-good of putlog holes and other breaks in the work. Scaffolding should be sound and in accordance with BS 5973.

On low-rise buildings where the final coat is to be roughcast or drycast, a friction grip, pole and pin scaffolding may be used.

Sufficient clearance should be allowed to enable satisfactory application of the rendered finish. This is particularly important when using mechanical methods.

41 Cleanliness and protection of adjacent work

All existing work and fittings that are likely to be damaged during the application of renderings should be protected.

Cleanliness is essential in all stages of the work. Gauge-boxes, tools and anything else used in the preparation or application of renderings should be kept clean. The banker board should be cleaned immediately after each batch of mixed material has been used.

Care should be taken to avoid splashing mortar on to finished surfaces of brickwork, joinery, paintwork and glass. Any splashes should be cleaned off immediately. Wet- and dry-dash treatment can be a particular danger to glass.

On completion, any mortar splashes formerly missed should be carefully removed and the whole of the work, including the rendering, should be left clean.

42 Proportioning

Mixes are usually proportioned by volume. Normally, sand is assumed to be damp and no allowance for variation in bulking is made. Use of dry sand will, however, affect the mix proportions and, if the sand is dry, slightly less sand should be used. If a harsh sand is being used together with dry hydrated lime, the proportions of lime may be increased by up to 50 %. Alternatively, by agreement, a plasticizer may be incorporated in addition to the lime.

NOTE 1 The mix proportions shown in Table 1 are for damp sand which is different from other codes of practice where mortars are proportioned by volume of dry sand.

Volume batching should be carried out using properly constructed gauge boxes. Volume batching "by the shovel full" is grossly inaccurate and is likely to cause faults in the finished rendering. (See Table 1, Table 2 and Table 3.)

NOTE 2 The lime in ready-mixed lime : sand does not increase the volume of sand. For example, a cement : lime : sand mix of 1 : 2 : 9 should have one volume of cement mixed with nine (not eleven) volumes of 1 : 4½ ready-mixed lime : sand.

Wherever possible, whole bags of cement or hydrated lime should be used for a mix. For practical purposes, a 50 kg bag of Portland cement and a 25 kg bag of hydrated lime should be considered to have equal volumes.

Admixtures should be dispensed accurately and for this purpose, measures of the correct size should be provided to operatives.

43 Mixing

43.1 General

Materials which have caked or have begun to harden should not be used. All materials should be free from frost.

It is preferred that renderings be mixed by machine. Where they are mixed by hand, mixing should be done on a banker board or platform following the procedures for mechanical mixing given in **43.2** to **43.5**. The board or platform should be cleaned after each batch has been removed and before preparation of another is begun. Mixing should continue until the materials are workable and of a uniform colour and consistency.

Site gauged mixes should normally be used within 2 h of adding the cement in summer and 3 h in winter.

Only clean water should be added to bagged dry ready-mixed materials. They should be mixed as recommended by the manufacturer.

43.2 Preparing mixes of cement : lime : sand

Ready-mixed lime : sand (coarse staff) and some water should be placed in the mixer first and the cement gradually added whilst mixing. Mixing should continue until the material is uniform in appearance. Water should then be added while continuing mixing until the required consistency is achieved.

Where hydrated lime is to be added on site, the sand should be placed in a mixer first, the lime and cement gradually added and, when the appearance is uniform, water added to give the required consistency.

43.3 Preparing mixes of cement and sand used with plasticizers

The sand and some water should be placed in the mixer first and the cement gradually added while mixing. Mixing should continue until the material is uniform in appearance. The recommended quantity of air-entraining plasticizer, diluted with a suitable amount of water, should then be added. Further water should be added whilst continuing mixing until the required consistency is achieved. Care should be taken to avoid overdosing or overmixing which may result in excessive air content leading to loss of strength and durability.

43.4 Preparing mixes of masonry cement and sand

Mixes consisting of masonry cement and sand should be prepared as in **43.2** except that only clean water should be added to the mixture of masonry cement and sand.

43.5 Preparing mixes containing fibres

Mixes for hand application that contain fibres should be prepared as described in **43.1**, the fibres being well beaten and thoroughly incorporated in the "coarse stuff" in the required proportions before gauging with cement.

44 Forming architectural features

Before the rendering is applied, string courses, mouldings and similar features should be set out and built up to the required shape and thickness or, alternatively, should be cast and fixed.

When forming large sections in thin layers, particular attention should be paid to providing a light-weight core. Building up material is preferable to applying thick layers.

45 Application of the various coats

45.1 General

Rendering should not be continued over movement joints, damp-proof courses, weep-holes or air vents.

The work should not be started until the background has been properly prepared (see clause **38**) and suitable weather conditions prevail. Rendering should not be applied to walls which have been recently subjected to prolonged rain. Work should be discontinued during inclement weather or periods of frost, unless the building has been enveloped and steps have been taken to maintain the temperature above 5 °C.

Before applying any coat, the background or preceding coat should be brushed down to remove any dirt and loose particles of sand and should be dampened if it is of a porous nature and very dry.

45.2 Curing

It is essential that a newly rendered surface be prevented from drying out too rapidly, although protection from the sun and wind, or spraying with water, may only be necessary in hot and dry weather. In sunny weather, the work should be carried out in the shade whenever possible, following the sun round as the day passes. Spatterdash, however, should be wetted down an hour or so after application to ensure adequate hydration.

Each coat should be allowed to shrink and dry out as long as possible normally for a period of several days, before the subsequent coat is applied. In cold wet weather this will take considerably longer than in warm dry weather.

Consideration should be given to more stringent than normal protection of coloured renderings and decorative finishes in hot weather, wind, rain, or other adverse conditions.

45.3 First undercoat

Application of the undercoat is best carried out in two operations. First, a "tight" thin coat should be applied using considerable pressure on the float: this should be followed quickly by a second application to bring the coat up to thickness. This is effective on all backgrounds and essential over concrete, raked brickwork and no-fines concrete.

The undercoat should be as uniform in thickness as possible; the thickness should be not less than 8 mm nor more than 12 mm, except in localized areas where the maximum should be 16 mm. When laid on with a trowel it should be flattened with a straightedge and left open.

If the undercoat is to receive a hand-applied finish, the surface should be combed or scratched after it has been left long enough to set firm, 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 right through the undercoat.

The surface should not be scratched, however, when it is to receive a machine-applied finish; instead, after being levelled with a straightedge, it should be lightly rubbed with a wood float.

Difficulty in application can sometimes be experienced when rendering on high suction backgrounds, due to rapid moisture loss from the mix. Methods of dealing with high suction are given in clause **38**. The use of water-retentive agents incorporated in the mix can also help to alleviate this (see **10.4**).

When rendering on a background which has been coated with an adhesive primer (see **38.2**) it is essential that the undercoat be applied while the primer is still wet.

When rendering on metal lathing, back rendering, if it can be applied, should be done when the first undercoat is hard enough to permit. The work should then be allowed to dry as completely as possible before applying further coats.

45.4 Subsequent undercoat

Before applying a second undercoat or floating coat, the first undercoat should be brushed down to remove any dust and loose particles and, if of a porous nature and dry, it should be lightly but uniformly wetted. This coat should be 6 mm to 10 mm thick and, unless it is to receive a machine-applied finish, the surface, when firm, should be combed or scratched; for a machine-applied finish, the surface should be lightly rubbed with a wood float.

45.5 Final coat

45.5.1 *General*

Before applying the final coat, the undercoat should be allowed to harden and dry out sufficiently to provide adequate suction. Where necessary, the suction of the undercoat should be reduced by uniformly wetting.

With drydash finish and certain textured finishes it is essential for the final coat to remain plastic for a longer time than normal. This can be assisted through reducing the suction of the undercoat by more thorough wetting down or preferably by using a waterproofing admixture in the undercoat mix, or a water-retentive agent in the final coat.

The final coat should be applied from top to bottom (except for "English Cottage" finish where the procedure should be reversed). Care should be taken to avoid introducing day joints at unplanned locations.

45.5.2 *Plain finishes*

The final coat should be thinner than its undercoat (generally less than 8 mm) and should be applied with a laying trowel and finished with a wood, felt, cork, or other suitably faced float. A steel trowel should not be used and over-working should be avoided. Water should not be applied to the surface of the final coat whilst working up, but patches showing signs of premature drying may be patted with a damp float.

45.5.3 *Scraped or textured finishes*

Various finishes can be obtained by using 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 should be applied to a thickness of between 8 mm to 11 mm, of which about 3 mm is removed in the scraping process. An old saw blade or float faced with expanded metal is often used for the purpose.

Scraping should 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 ambient conditions. The surface of the rendering should be removed to expose the aggregate. The texture obtained depends mainly on the grading of the aggregate.

45.5.4 *Roughcast finishes*

The mix, which should be both wet and cohesive, is thrown on by means of a trowel or scoop. Generally, the undercoat should be allowed to harden and dry out sufficiently to provide adequate suction. The finish should then be applied at such a rate to ensure the desired texture (see **33.3.2**). Alternatively the roughcast may be thrown onto a trowel-applied buttercoat approximately 5 mm thick (while it is still plastic) in a similar manner to that used for drydash.

45.5.5 *Drydash finishes*

The final coat should be laid on about 8 mm thick, depending upon aggregate size, and a rule or float should be passed lightly over to straighten it. The aggregate should be well washed and drained and thrown wet onto the final coat while it is still plastic.

The whole surface should be treated uniformly without interruptions within any one panel, which necessitates continuous working of the final coat over the whole face.

45.5.6 *Machine-applied finishes*

Some textured final coats are applied by machine. These are described in **33.3**. The precise method of application will depend on the particular machine used. Hand- or power-driven machines are suitable. Generally, the undercoat should be allowed to harden and dry out sufficiently to provide adequate suction. The finish should then be applied at such a rate as to ensure the desired texture.

46 Machine-applied renderings

The complete rendering may be mechanically spray-applied. Such application is usually by proprietary processes carried out by specialist contractors. The manufacturer's recommendations should be followed.

Two coats should normally be applied but three coats are often used on lathing or insulation (see clause **45**). If a textured finish is required, this should be done directly from the spray gun by adjusting the delivery speed. Either a heavy or light texture can be produced. There is some overspray from this operation and areas requiring protection should be masked.

47 Polymer-modified cement-based renderings

The rendering coatings should be applied in accordance with the manufacturer's recommended thicknesses. Thinner coats are used than with traditional rendering mixes and greater care should be taken to control and check the actual thickness applied. Inadequate coat thicknesses should be avoided as this may impair performance.

The manufacturer should be consulted as to the type of finish which can be applied to polymer-modified cement-based renderings over insulation boards. A smooth trowelled finish should not be used.

Polymer-modified cement-based renderings may also be subject to lime bloom and efflorescence as traditional mixes (see **34.1**).

Section 6. Maintenance and repair

48 General

If proper attention has been given to external details in designing the structure, and the rendering materials and method of application are in accordance with the recommendations of this British Standard, external rendered finishes should not require any maintenance over a long period.

Maintenance and repair work on renderings may be required on decayed or deteriorated work not necessarily applied in accordance with the recommendations of this British Standard or as a result of alterations or accidental damage.

49 Inspection

The precise nature and extent of the defects should be ascertained by means of a careful inspection by someone knowledgeable and experienced in the subject. Common defects are likely to include cracking and loss of adhesion between rendering and background, often leading to spalling of areas of the rendering. Reasons for such defects include moisture, thermal and structural movement of the rendering/background, frost action and chemical reaction between the rendering and soluble salts in the background (sulphate attack).

It is important to ascertain the basic cause of the defects especially where they are due to inappropriate design or deficiencies in the background. Where serious defects are suspected, the method of inspection outlined in Appendix A should be followed.

50 Repairs to cracks

50.1 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.

50.2 Rendered finishes only

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 coating or other decorative treatment may be adequate to close and conceal the cracks (see clause **52**).

Cracks which form in rendered finishes and do not penetrate into the background can sometimes be attributed to failure of adhesion adjacent to the crack. In order to carry out satisfactory repairs, the area surrounding the crack should be tested for hollowness by tapping the surface, and the hollow areas should be cut out. If hollowness is not detected, the material on both sides of the crack should be cut out to a total width of not less than 75 mm. Any material that develops hollowness or loses its adhesion during cutting out should also be removed. A hand-held power tool with a carborundum or diamond abrasive disk is useful for this operation and minimizes risk of producing further hollowness. The edges of the cut material should be left slightly undercut and the background well brushed and washed to remove any dust or loose material.

Once the area has been prepared the rendering should be repaired as described in **51.2**.

50.3 Rendering and background

Where cracks penetrate not only the rendering but also the background, the cause of the cracking should be ascertained and dealt with before proceeding with the repair. The background should first be made good. Where it is not possible to effect complete repair of the background, the rendering should be cut back on both sides of the crack for at least 150 mm and light expanded metal over building paper or polyethylene sheet should be fixed to the background and embedded in the undercoat of the rendering; the area should then be repaired as described in **51.2**. This method may not entirely prevent further cracking but it should reduce its severity.

Cracks in the rendering may be caused by the expansion of mortar joints in the background due to the action of frost or soluble salts. If such a background is not rebuilt, any re-rendering of it should be separately supported on lathing over a breather membrane.

Cracks occurring at the junction of dissimilar materials, i.e. on mixed background, should be dealt with as described in **27.3**.

50.4 Making good to 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 British Standard. Since it is unlikely that the areas made good will exactly match existing work, consideration should be given to the possibility of coating the whole of the required work with a cement paint or other decorative coating.

51 Repair of hollow or detached areas

51.1 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. In addition to repairing the damage, it is essential to determine and deal with the cause.

Loss of adhesion may arise from various causes. Defective design or detailing may allow water to penetrate which can lead to expansion of the background due to the action of sulphate salts, or to damage as a result of frost action. Loss of adhesion may also arise from incorrect composition of the rendering in relation to the background.

Where water penetration is an obvious or suspected cause of failure, this should first be remedied. Preventing ingress of water may minimize further sulphate action and should be effective against frost attack.

51.2 Rendered finish only

When the causes of failure have been dealt with, the patches of damaged rendering should be cut out cleanly, preferably in rectangular areas, down to the background. The exposed edges of the rendering should be slightly undercut. The exposed surface of the background should be well brushed to remove dirt or loose material and should be washed. The area cut out should be made good according to the nature of the background and the type of finish as described for new work in this British Standard. Bonding agents are particularly useful when carrying out minor patching work (see **38.2**). The colour and texture of the new rendering should be matched as closely as possible to the existing work; for this purpose, the sand for the mix should be carefully selected and pigments should be incorporated as required. It is desirable to prepare small test panels and leave them to dry thoroughly before comparisons are made and the mix is decided upon.

51.3 Spalled backgrounds

All loose and flaking material should be cut back to a firm base. The removed material should be replaced with new bricks or blocks or made up with layers of mortar. Each layer of mortar should be firmly bonded, not more than 16 mm thick, and allowed to dry before a subsequent layer is applied. Once the hole has been filled level with the surface of the background, the rendering should be repaired as described in **51.2**.

52 Overcoming unsatisfactory appearance

52.1 General

It may be desired to improve the appearance of a rendering because of unsatisfactory quality, discoloration, excessive patching or deposition of dirt, or for other aesthetic reasons.

This is normally effected by cleaning, painting or applying further rendering coats. Before applying any new coating, all cracks and defects should be made good as described in clauses **50** and **51**, and the surface should be properly prepared.

52.2 Cleaning

Rendered finishes should be cleaned by dry brushing or by washing down with water applied through a fine jet at mains pressure. Before cleaning, any organic growths of fungi, algae, etc. should be removed as described in **38.1**.

52.3 Paint treatment

External rendering may be painted satisfactorily with various types of paints such as cement paints, exterior quality emulsion paints, masonry paints and coatings, bituminous emulsion paints and oil paints of appropriate types. Some paints can reduce the rate of evaporation of moisture which might be present in the wall and generally, the more permeable types of paint are to be recommended. Reference should be made to BS 6150 and to BRE Digests[4)] 197-1 and 198-2 for the selection and application of suitable materials.

52.4 Further rendering coats

Additional coats of rendering can only be applied safely when the existing work is sound and has satisfactory adhesion over the whole of the area involved. Further rendering coats should not be applied over soft friable material or where the existing thickness of rendering is significantly greater than 19 mm. Renderings which have a roughcast, pebble-dashed, or similar finish will normally provide an adequate key. The key of plain or floated finishes should be improved by hacking or the use of a spatterdash, stipple or adhesive primer (see **38.2**). Before commencing, the existing rendering should be cleaned down as described in **38.1**. If the rendering has been treated with a water repellent or has been painted, difficulty may be experienced in obtaining adhesion.

Special renderings which contain polymers are available for renovation work. These renderings have improved adhesion properties and can be applied in thinner coats than traditional renderings.

[4)] Published by the Building Research Establishment (BRE) and available from HMSO.

53 Overcoming water penetration

53.1 General

The causes of water penetration through renderings are discussed in clause **19**. Where such penetration is due to the presence of cracks, these should be dealt with as described in clause **50**. Where water penetration results from defective design features, these should be remedied. Where penetration cannot be assigned to either of the above causes, surface treatment may be applied.

53.2 Colourless treatments

The surface of the rendering can be made water repellent by applying one of the purpose-made colourless treatments. These consist of solutions of silicones, resins, waxes or of aluminium stearate compounds, etc. It should be noted, however, that some treatments reduce the rate of evaporation of moisture which might be present in walls. These materials are proprietary and should be applied in accordance with the manufacturer's instructions. It is preferable for the water repellent treatment to be permeable to water vapour. All types need renewing after a period of some years. Reference should also be made to BS 6477.

53.3 Paint treatments

Paint, regularly applied, can effectively prevent rain penetration through renderings.

It should be applied as described in BS 6150. Reference should also be made to BRE Digests 197-1 and 198-2 for the selection and application of suitable materials.

54 Repairs to painted rendering or stucco

Painted rendering forms a large proportion of older external finishes that may need repair. The nature of the rendering and the character of the defects should be carefully examined before deciding upon the remedial treatment to be given.

When the render itself is cracked or damaged, the advice in clauses **51** and **52** should be followed, taking care to match the strength of the repair with the existing rendering especially with the older renderings and ensuring that the paint used for retreatment is vapour permeable. A check should also be made that the new paint will not cause delamination of existing layers of paint.

In situations where only the paintwork is cracked or defective, the remedial work should be limited to the restoration of the paintwork.

In each case, the recommendations given in BS 6150 should be followed for the preparation prior to painting and the repainting.

Appendix A Inspection of defective renderings

A.1 As cementitious-based materials tend to shrink on drying (see **31.2**), it is not practical to expect to find a rendering surface completely free of cracks or hollow sounding areas. Some minor faults may not affect serviceability and may only detract from the appearance of the rendering. However, when it is suspected that serious faults are present, a more detailed investigation should be carried out as outlined in **A.2**.

It is rarely satisfactory casually to inspect just the damaged area, because the defect may be repeated in other areas which in future years may fail and lead to a series of repairs. A whole wall, a complete building, a representative sample of buildings or every wall of every building may need to be inspected.

A.2 Before inspection, available information should be collected on the wall construction, date of building, weather at the time of building, rendering specification and dates of rendering. Suspect renderings should be inspected systematically and thoroughly if a full appreciation of the extent of damage is to be obtained. Defects usually fall into four categories as follows:

a) cracking;

b) delamination;

c) rain penetration;

d) unsatisfactory appearance.

A thorough inspection may include the following:

1) locating all significant cracks (generally those greater those than 0.5 mm);

2) arranging for measurement of cracks which may be active;

3) sounding the whole area of rendering to detect detached area;

4) assessing the wall for movement;

5) checking the construction details;

6) identifying the source and extent of all stains, organic growths damage and deterioration.

Some information may be obtained from chemical analysis and physical testing of samples. These results are usually open to a wide range of interpretations due to uncertainties in the assumptions made and should only be used to supplement detailed informed inspection.

The shading conventions given in Figure 9 can be used to illustrate sketches of defective rendering (a scale of 1 : 100 is usually appropriate).

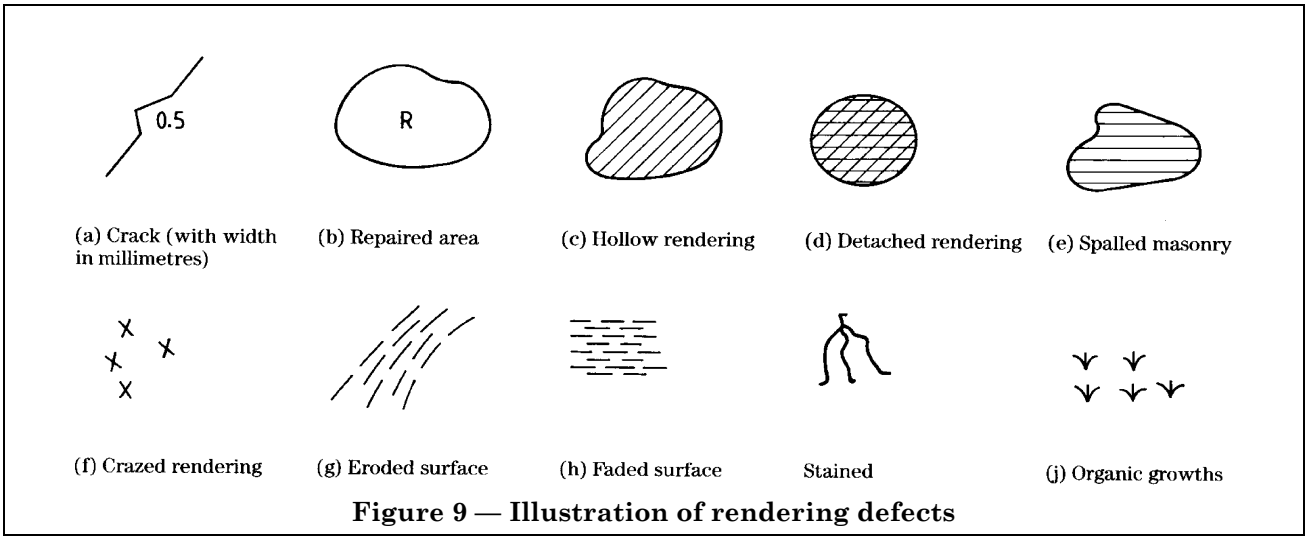


Figure 9 — Illustration of rendering defects

Publication(s) referred to

BS 12, *Specification for Portland cements.*
BS 63, *Road aggregates.*
BS 63-2, *Specification for single-sized aggregate for surface dressing.*
BS 146, *Specification for Portland-blastfurnace cement.*
BS 443, *Specification for testing zinc coatings on steel wire and for quality requirements.*
BS 476, *Fire tests on building materials and structures.*
BS 476-4, *Non-combustibility test for materials.*
BS 729, *Specification for hot dip galvanized coatings on iron and steel articles.*
BS 882, *Specification for aggregates from natural sources for concrete.*
BS 890, *Specification for building limes.*
BS 1014, *Specification for pigments for Portland cement and Portland cement products.*
BS 1199 and BS 1200, *Specifications for building sands from natural sources.*
BS 1202, *Specification for nails.*
BS 1202-1, *Steel nails.*
BS 1369, *Steel lathing for internal plastering and external rendering.*
BS 1369-1, *Specification for expanded metal and ribbed lathing.*
BS 1449, *Steel plate, sheet and strip.*
BS 1449-2, *Specification for stainless and heat-resisting steel plate, sheet and strip.*
BS 1554, *Specification for stainless and heat-resisting steel round wire.*
BS 1706, *Method for specifying electroplated coatings of zinc and cadmium on iron and steel.*
BS 2989, *Specification for continuously hot-dip zinc coated and iron-zinc alloy coated steel: wide strip, sheet/plate and slit wide strip.*
BS 3148, *Methods of test for water for making concrete (including notes on the suitability of the water).*
BS 3921, *Specification for clay bricks.*
BS 4016, *Specification for building papers (breather type).*
BS 4027, *Specification for sulphate-resisting Portland cement.*
BS 4721, *Specification for ready-mixed building mortars.*
BS 4887, *Mortar admixtures.*
BS 4887-1, *Specification for air-entraining (plasticizing) admixtures.*
BS 4921, *Specification for sherardized coatings on iron or steel.*
BS 5224, *Specification for masonry cement.*
BS 5385, *Wall and floor tiling.*
BS 5385-2, *Code of practice for external ceramic wall tiling and mosaics.*
BS 5628, *Code of practice for use of masonry.*
BS 5628-3, *Materials and components, design and workmanship.*
BS 5642, *Sills and copings .*
BS 5642-2, *Specification for copings of precast concrete, cast stone, clayware, slate and natural stone.*
BS 5973, *Code of practice for access and working scaffolds and special scaffold structures in steel.*
BS 6093, *Code of practice for design of joints and jointing in building construction.*
BS 6100, *Glossary of building and civil engineering terms.*
BS 6100-6, *Concrete and plaster.*
BS 6150, *Code of practice for painting of buildings.*
BS 6461, *Installation of chimneys and flues for domestic appliances burning solid fuel (including wood and peat).*
BS 6461-1, *Code of practice for masonry chimneys and flue pipes .*
BS 6477, *Specification for water repellents for masonry surfaces.*
BS 6510, *Specification for steel windows, sills, window boards and doors.*

BS 8000, *Workmanship on building sites.*
BS 8000-10, *Code of practice for plastering and rendering.*
CP 3, *Code of basic data for the design of buildings.*
CP 3:Chapter IX , *Durability.*
DD 93, *Methods for assessing exposure to wind-driven rain.*
BRE Digest No. 77 *"Damp proof courses"*[5)].
BRE Digest No. 89 *"Sulphate attack on brickwork"*[5)].
BRE Digest No. 139 *"Control of lichens, moulds and similar growths"*[5)].
BRE Digest No. 197 *"Painting walls"* Part 1 *"Choice of paint"*[5)].
BRE Digest No. 198 *"Painting walls"* Part 2 *"Failures and remedies"*[5)].

[5)] Published by the Building Research Establishment (BRE) and available from HMSO.

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