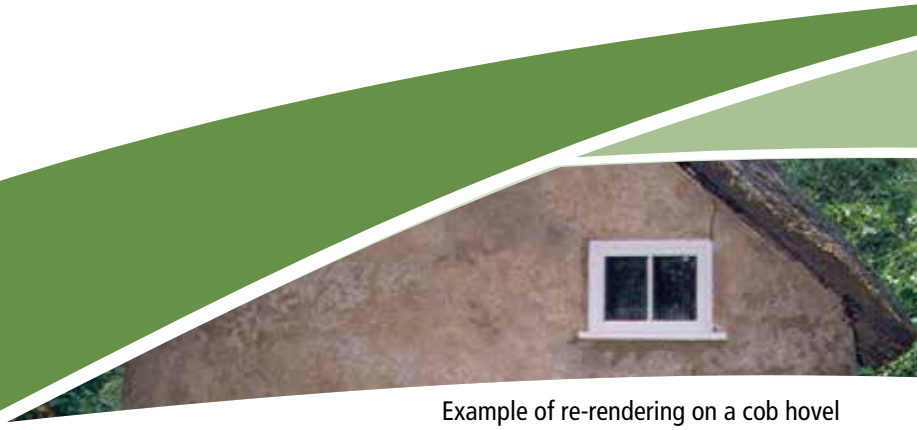
NEW FOREST NATIONAL PARK

New Forest DISTRICT COUNCIL



Example of re-rendering on a cob hovel

Historic buildings

Plasters and renders

This leaflet describes the character and appearance of traditional lime plasters and renders in the area as well as some of the problems encountered. It also offers suggestions on appropriate methods and materials for use in repair.

There is a list of references and useful contacts on the last page.

Original plaster on split laths, in a mid-C16th timber framed farmhouse

Introduction

'Plaster' is the term usually given to applied internal ceiling and wall finishes. Its finish is smooth and it serves to hide the structure beneath. It tends to be applied in two or three coats depending upon the substrate.

When used on ceilings it is applied over wooden laths in three or more coats. Similarly, wooden laths may be fixed to timber stud partitions. Alternatively the plaster may be applied direct to the masonry.

Description

For the purposes of this leaflet traditional plaster was usually made from lime, either non-hydraulic (the traditional material which sets through drying in the air) or hydraulic, (a much later invention which sets chemically with water).

On internal work ox, goat or horse hair was used for reinforcing or binding the base coats, although grass, water reed or straw was also sometimes used.

Lime was combined with a 'filler', in the form of well graded sand or grit to make plasters. Other fillers such as brick dust, chalk or sea shell were also used. Such fillers usually occupied about 70% of the volume of the mix.

Modern gypsum plaster is a common mineral consisting of hydrated calcium sulphate, and is obtained from natural sources or as a by-product of certain industrial processes. It is usually applied in two or three coats, with the base coat being the coarsest, and the finishing coat the finest. This material tends to be stiff, and waterproof, and it can prevent a wall from breathing. It should generally not be used for historic building repairs.

'Render' usually refers to the hard-wearing limebased plaster which protects external walls from weather, but may also act as a decorative covering, to enhance architectural quality. Sometimes it was applied simply to hide poorly built walls. As with plaster, lime was combined with sand or grit. The appearance is less shiny than internal plaster.

'Roman cement' is a chemically setting lime render which is breathable and dense but not as inflexible as modern cement. 'Roughcast', by definition a more roughly applied, 'lumpier' render mix, made up of large stoney aggregates, can more suitably be applied to ragged edges of existing render as the joint between new and old work is more readily disguised.

Modern Portland cement is sometimes, inadvisably and inappropriately, used to render old external walls. Some believe that because it is waterproof and strong, it will help to ensure the structure remains dry and in good condition. This is far from true.

This church in South Baddesley, built in two phases in 1818 and 1858, is rendered in Roman cement

A section of dense cement render lifting off a weak cob substrate, allowing rain to penetrate

History

The Romans introduced limebased plasters and renders to Britain. Prior to this, clay mortars were used in combination with mud, chalk and straw.

These early limes were simply burnt limestone, which had been 'slaked', or put into water, to turn it into lime putty. Such limebased plasters were 'nonhydraulic;' which means that they set through drying in the air, rather than through any chemical process. Consequently they took a very long time to set if the weather conditions were not perfect. Nonetheless, simple lime plasters were used into the 20th century.

External renders, which were basically lime mixed with various grades of sand, have been used for thousands of years. 'Stucco', which became the most commonly used form of external render during the Georgian period, was simply a build up of several coats of lime render, finished to represent finely tooled stone work.

It was only in the year 1756 that experiments with chemically setting hydraulic limes began. This sort of lime has a proportion of silica and alumina in it, which reacts with the lime to set chemically.

Further inventions included 'Roman' cement (1796) which was actually a very hydraulic lime. The first Portland cement was invented in 1824 and Improved Portland cement (1852) increased the choice of coating available.

Modern cement and gypsum

Cements such as 'Ordinary Portland', which is the most common, are very strong, inflexible and waterproof. Their application to old buildings is inappropriate and could damage the substrate, which is usually far softer and more flexible than cement. This inflexibility does not allow for seasonal movement of the structure, like lime does.

When cement cracks (which in time it usually does), water can readily penetrate down the back of the crack. Localised areas of dampness develop, which can lead to rot. It can also freeze, expand and 'blow' the render off the wall - sometimes damaging the structural fabric below.

Unfortunately however, some walls have been fully coated in cement. In these cases, it may not be advisable to remove the coating, as this could seriously damage the material beneath. A small patch in a discrete part of the wall should be removed as a test to clarify whether damage is caused by its removal.

If there are small areas of damage to cement render, then repairs should use cement of similar density and strength. In these instances, using lime is not appropriate because the different degrees of expansion and flexibility will cause further cracking, so allowing more water into the crack. In the case of a listed building, if you wish to remove an entire wall of cement render, listed building consent will be required.

The use of modern bagged gypsum in plastering, even for small areas of patch repair, is not appropriate, as it is incompatible with lime plaster, for several reasons. Most types usually break down in the presence of moisture. However, whilst some bagged gypsum does resist the action of dampness, it contains a water repellent that seals the surface of the wall and prevents it from breathing. Gypsum is also very rigid and inflexible, it sets rapidly and can cause cracking at the edges where it joins with lime plaster. Its appearance is also different. It is smooth and usually finished mirror-smooth, rather than textured, like lime plaster.

This patched ceiling and wall plaster continues to be affected by damp, as the cause of the problem has not been rectified

Bulging plaster was removed from this ceiling, as were the damaged laths, in preparation for replacement and re-plastering following successful repair to the roof

Problems and repair

Reasons for deterioration

Building movement

Cause - through structural failure, vibration, or shrinkage, for example of structural timbers which slowly shrink as they dry, causing tension and compression across ceilings.

Symptom - this may result in cracking of the plaster or its bulging as a result of loss of adhesion from the backing. Similarly, render may crack or detach from its backing.

Poor application

Cause - excessive thicknesses of plaster coats, lack of suction control between coats or very strong final coats being applied over weaker substrates.

Symptom - the different coats of plaster may bulge and separate. Shrinkage and crazing of the surface may occur. Render may detach from its backing.

Problems with supporting timbers

Cause - through decay as a result of damp or insect attack or structural failure.

Symptom - cracking or bulging of plaster may result.

Water ingress

Cause - from leaking roofs, rising damp or damaged water pipes, including rainwater goods.

Symptom - Staining is usually present. Also, an entire area of plaster or render may bulge or it generally may just become soft and spongy.

Problems with laths

Cause - decay, as a result of insect attack, or water ingress, or failure as a result of movement of supporting timbers, or the laths detaching from supporting timbers due to decay of fixings.

Symptom - Bulging of the plaster is likely to occur.

When looking at problem areas, great care must be taken to analyse the situation thoroughly. There may be several reasons why a surface is failing. All reasons for a failure must be assessed and understood. It is vital that the cause of the failure is treated, rather than just the symptom - which will no doubt re-occur if left unattended.

The following questions should be asked, check-list style, to determine the cause of the problem before any remedial work is carried out:

1 What are the symptoms of the problem?

2 Which materials are involved?

3 How is the problem area constructed?

4 What are the causes of the problem?

5 How can the causes be treated?

6 How can the symptoms be treated?

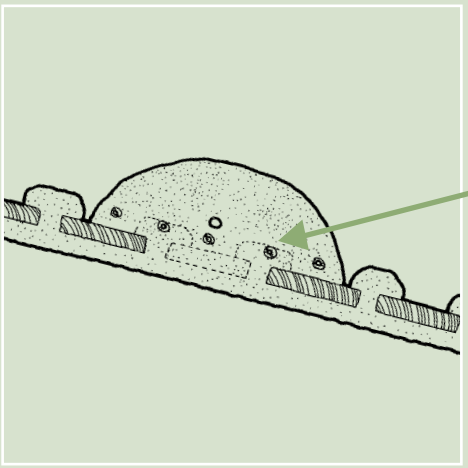
Having answered these questions, one must consider the choice of materials very carefully.

New work must very closely match existing in constituent parts and proportions, texture and in consistency. This is necessary both to maintain the character of the building but also the effectiveness of the plaster or render.

In the case of a listed building, limited patch repairs using exactly the same materials and techniques as existing do not require listed building consent (lbc). However, if you intend to replace the existing plaster to an entire wall, or remove the laths and plaster to a whole ceiling, then you will require lbc before the work is carried out, because the extent of the new work could affect the character of the building.

Similarly, you will require lbc prior to employing different materials or techniques to those currently used. In some cases this will be acceptable; for instance if you propose to remove a patch of cement render in an otherwise lime rendered wall, to replace it with lime. In some cases however, this will not be acceptable; for instance if it were proposed to take off all the laths and plaster to an old ceiling and re-cover with plasterboard and modern gypsum plaster.

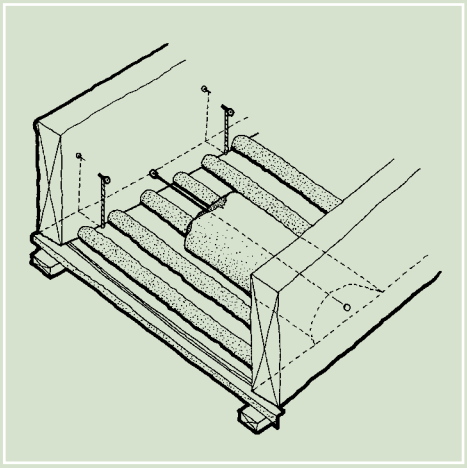
It should be noted that it is for the Planning Authority to determine whether there is a requirement for lbc or not, rather than the owners or occupiers of a property.



The Plaster of Paris mix is laid over the void left by the removal of the failed lath

Brass screws and copper wires

Timber props placed on the underside of the ceiling support the section to be repaired



Interior plaster

Some methods for repairing internal plaster, once the cause has been identified and if appropriate, independently rectified, are explained below.

Defective laths

Repair work can focus on remedying the failing laths rather than removing the plaster coats where access to the void behind is practical. A recognised method for replacing failing laths is described below:

1 From above, the joists and plaster ceiling are cleaned using a vacuum cleaner.

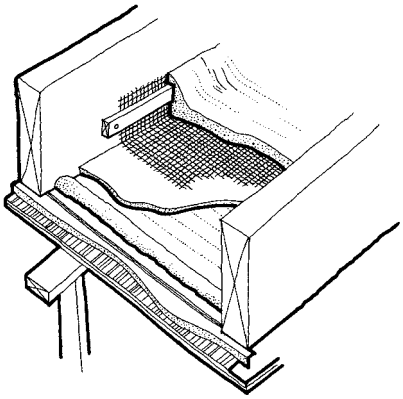
2 Sagging areas of ceiling are supported from below using props, or from above using timber supports and 'wire hangers'.

3 Decayed laths are sawn through and removed, from above.

4 The plaster void, created by the removal of the old laths, as well as the laths and plaster immediately surrounding the exposed plaster, is then painted with a coat of PVA. This helps to control suction and the rapid removal of the water from the subsequently applied new plaster.

5 Several brass screws are then fixed into the joists either side of the void and copper wire lashed across the gap.

6 This 'reinforcing' wire is then overlaid by a mix of fine Plaster of Paris, retarded with a mix of PVA and water, to prevent rapid setting.



Gauze spreads the load efficiently and reinforces the new plaster layer.

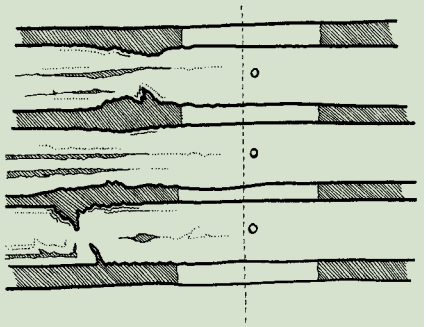
For larger sections of unsupported plaster, the void is filled with a layer of Plaster of Paris as before, but instead of copper wire, copper gauze is fitted between the joists and attached to them by battens. This technique helps to spread the additional weight of new plaster more effectively across the affected area.

The gauze is worked into the wet plaster, so that it becomes submersed. On top of this wet mix another coat of plaster is gently poured, creating a reinforced plaster sandwich. The depth of the plaster sandwich should not exceed about 18mm.

If, on investigation, laths are found to be defective, but access through ceiling voids is not practical, or if dealing with laths on a stud wall, an alternative approach must be adopted. This involves cutting through the plaster to remove the laths, from within the room. The timber studs or joists onto which the failed laths are fixed must first be located. This can be done by carefully examining the shape of the surface, which sometimes is pronounced at the point of the structural timbers.

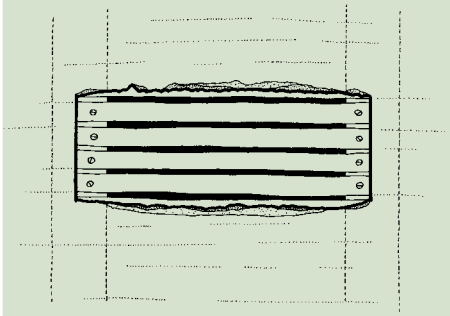
Alternatively, tapping the surface of the wall or ceiling to detect differing densities is possible. The location of the studs or joists should be confirmed by drilling a small sharp drill bit through the plaster. The difference in resistance between thin laths and structural timbers will be immediately noticeable. In many old houses, timber studs are no more than 2" (5cm) wide, and are placed at regular intervals across a wall, usually between 15" (38cm) and 18" (45cm) apart. Ceiling joists tend to be similarly spaced.

With a small saw blade the laths should be carefully cut back to about 1" (2.5cm) past the ends of the nearest joists or supporting timbers, and removed.



Defective laths are cut off close to the centre line of the timbers behind

A new section of laths screwed into timber behind



Laths should be replaced with matching sections of timber. The gap between each lath should not exceed the depth of individual laths, but should be adequate to allow the plaster to push through as this is how it is held in place.

Fixing laths with nails might cause vibrations to the surrounding plaster, or even split the ends of the lath. It is therefore usually better to drill a pilot hole in the lath and screw into place using brass screws.

If laths are sound but have pulled away from the joists to create a sagging ceiling or bulging wall, the laths should be carefully re-fixed using brass screws with wide flat washers and gauze washers over. These additional gauze washers provide adhesion for the plaster. The plaster immediately surrounding the holes must be cut away to provide sound fixing. Once the laths have been refixed the plaster itself can be repaired.

Traditional timber laths were commonly made from riven oak or chestnut

Bulging and separating plaster on masonry

It may be possible to re-adhere separating or bulging plaster. In some instances small bulges can be simply pinned back to the wall using brass screws and plugs. However on larger bulges, the space between the wall and the back face of the plaster will probably need to be cleaned out before re-fixing. Over time, the back of the plaster may have deteriorated, crumbled and collected at the base of the void, (which probably increased the bulging). Small horizontal slots are cut along the wall at this point, in order to spray lime water into the gap, to flush out the debris. Holes are also drilled at regular centres around the bulging area.

A syringe is used to inject lime putty grout to loosely fill up the space. Immediately following this, brass screws and plugs are fixed into the holes to secure the plaster against the wall.

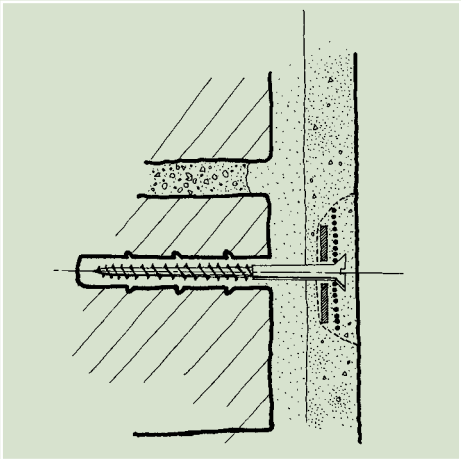
If the exposed edges of the existing plaster are loose, they should be carefully pinned back using brass screws and plugs.

When fixing plaster with screws, the heads of all screws must be countersunk beneath the surface level of the finished plaster, to ensure that they are hidden from view. As with securing plaster ceilings, the screws should be fixed with large brass washers as well as copper gauze or mesh washers which act to bond the lime applied over the screw head.

Cracked, spongy and missing plaster and separating plaster that cannot be fixed

When the existing plaster cannot be re-fixed then steps must be taken to replace, usually locally, the defective material. Lime plaster is, by its nature, soft. Unlike its modern counterparts it can easily be removed by hand. Care must therefore be taken to ensure that only the defective plaster is removed.

Once loose material has been carefully removed, then steps for the application of new plaster can commence.



Head of screw is sunken beneath the finished surface of the new plaster

Example of badly cracked render

Applying new plaster

The wall or laths beneath must be in sound condition. Any loose material or dust should be removed with a stiff bristle brush or churn brush.

The plaster should be applied usually in three coats to match the surrounding work. The thickness and mix for each coat will vary.

- Render coat (first coat applied to ceiling or stud wall) 3/8" (9mm) - 1 lime putty, 3 well graded sand, reinforced with hair.
- Float coat (middle coat) 1/4" (6mm) - 1 lime putty, 3 well graded sand. This may also be reinforced with hair.
- Set coat (top coat) 1/8" (3mm) - 3 lime putty, 2 fine sand.

Sound plaster surrounding the exposed area should be damped sufficiently prior to application of each coat, in order to slow down absorption of water from the new plaster. Doing this allows the new work to dry naturally, so creating sufficient bond with the laths or masonry or any previous layers of plaster and the surrounding plaster.

On completion of applying each undercoat, whilst the plaster is still wet, the surface of the existing layer should be scratched to create a key to adhere to. Time must be taken between coats for proper setting. First and second coats should be overcoated when 'green hard'. This is when it's too hard to dent with a knuckle, but just soft enough to mark with a thumbnail. Wetting between coats is important to ensure good bond. The top coat is applied in three operations.

Firstly, it is trowelled on. Then it is smoothed, and finally it is scoured with a cross-grained wood float, lubricated with water, to avoid shrink-cracking. This creates a hard, dense and flat, though not mirror-like, surface.

If external corners of walls need to be repaired, for instance the corners of a chimney breast, then no metal beads or fixed guides should be used to create artificially straight corners.

Special Plaster Techniques

Among the various materials used for constructing columns, dado rails, picture rails and cornices, special plastering techniques were used. These include: scagliola, a very fine plaster with marble chips, made to closely copy true marble; marezzo marble, which uses pigments instead of marble chips to create a similar effect; and sgraffito, which is scratched decoration in plaster. These techniques of decorating plaster may adorn some of the finer houses in the area.

Their repair should always be carried out by specialists with a proven track record in such fine work. Any proposal for the removal and replacement of such plaster will generally be refused listed building consent.

Demonstration showing lime plastering onto lath

Constructing plasterwork moulding for a moulded ceiling rose

The render was so poor on this property that it was almost wholly removed before re-rendering

Repair to this stucco wall stands out as the mortar is a darker colour than the original wall

External lime render

As with internal plaster, once the cause of the problem has been identified and, if appropriate, independently rectified, repair can take place.

Extent of repair

Simple patch repairing is the traditional approach to maintenance and although likely to create an irregular finish, is the preferred option.

The extent of repair necessary should be carefully ascertained by tapping the surface. Render that has detached from the backing will produce a hollow sound and may be noticeably loose. Only the very minimum should be taken off.

Many old buildings show generations of patch repair, which adds positively to the character of the structure.

Applying new render

Plastering bead, fixed guides, metal lath or chicken wire must not be used to artificially straighten the edges of the wall. The render should follow the line of the building.

As a guide, two thin coats, each approximately 6mm thick, should be applied to the wall. If both coats are to be put on smoothly, then the first coat should be scored in a diamond pattern (about 75mm wide) to provide a good key for the second coat. Wetting between coats is necessary. Plaster should feather away at its edges, for instance against stone corner blocks or existing sections of render.

The thickness and mix will vary, but a traditional combination of coats is shown below.

- Render coat (9mm) 2 lime putty, 5 sand.
- Float coat (9mm) 2 lime putty, 5 sand.
- Finish coat (6mm) 1 lime putty, 3 sand.

When applying lime render, weather conditions must be taken into account. Where there is a risk of hot sun or drying winds, some form of protection should be erected in order to prevent rapid drying, which would cause the render to drop off. Render should not be applied when there is any risk of frost. In this instance, the render will lose adhesion before set has occurred and again, in due course, will drop off.

Stucco

The formality of stucco means that more effort needs to be taken to disguise repairs than in the case of humbler, vernacular buildings.

When wet, new stucco is usually 'lined out' to imitate large smooth faced stone blocks, which are known as ashlar. If a section of this material requires replacement, then it must be carefully cut out to follow the joint lines incised in the render - even if this means removing a little of the sound stucco in the process. Unlined stucco should be cut to rectangular profiles, if necessary extending the repair as before, where possible using details of the building to disguise any joints in the new material.

A cob hovel, before and after rendering

Before

After

Historic cements

Roman cements tend to be applied smoothly to walls. Any missing areas should be repaired by cutting out neat rectangular sections and reapplying as above. Traditionally the mix was 1 part hydraulic lime, 1 part gritty sand.

Early Portland and improved Portland cements were also usually applied smoothly. Traditionally, the mix for this material was generally between 1 part cement and 5.5 to 8 parts gritty sand.

Plaster and render materials

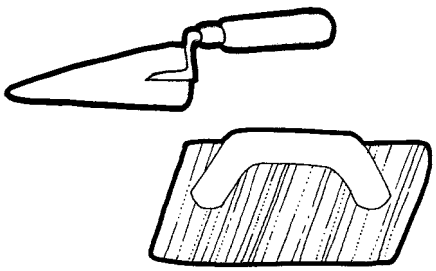
In all cases of repair, the new materials need to be compatible with the existing in terms of size of aggregate, consistency, texture and degree of adhesion.

For plaster, 'well graded' means that aggregates should range in size from extremely fine up to about 0.6mm diameter and in shape from rounded to angular, in order to create a strong matrix for sound bonding. The air trapped within this sort of mix also helps setting.

Hair in plaster should be approximately 1" long, and coarse. Goat hair is ideal, as is hair from the body of a horse. Both mane and tail hair is too shiny, as is human hair. This should be added to the plaster at the time of mixing and immediately before application, because the alkalinity of wet lime attacks the protein in the hair and over a period of weeks and months may break it down.

Clumps of hair create weak spots in the finished work and can be as detrimental to the integrity of the plaster as using no hair at all.

For external renders the sand should also be well graded, but in size should range from extremely fine up to about 1.2mm in diameter.



Grouting trowel and wooden float

Tools and techniques

Lime plaster is best applied by using a gauging trowel, which is easier to use than the standard plastering trowel. The small surface area of the trowel means that more pressure can be applied to firming the plaster onto the backing. It also means that on walls that are not completely flat (probably most of them) it is more manageable to use.

Backing coats are scored using a scratcher. For smooth external render, throwing the first coat on is a good method of application as it tends to adhere well to the wall. The second coat should be put on with a wooden float and finished with circular strokes to leave a smooth, but not polished, surface. Neither coat should exceed 6mm. If the first coat is to be floated rather than thrown, then it must be scratched to give a key for the second floated coat.

For external roughcast render throwing is the best method to use. The tool best suited is called a dashing trowel, but an adapted coal shovel is as effective. The end of the trowel should be sawn off to create a roughly square surface area. A back hand action is used to throw the render. When the first coat is green-hard a wooden block should be used to scrub away any high points in the finish.

After light re-wetting, the second coat can be thrown. Where render is to be thrown it is sensible to protect windows and doors perhaps with polythene sheeting, and cover drains.

Limewash is the preferred finish on traditional buildings as it allows the structure to breathe, enabling damp to evaporate away rather than being trapped in the wall

Limewash and distemper products in a range of ready-mixed colours (photo © Mike Wye & Associates)

Decorating new lime plaster and render

New lime plaster should be decorated with limewash. This water-thin coating usually consists of 1 part lime, 2 parts water. If however, following mixing but prior to application, the limewash in the bucket is found to have a sludge at the bottom, then a little more water is required to mix the constituent parts together.

The first coat of wash should be painted onto a damp wall, from the top down, to avoid streaking. A whole area of wall should be painted in one go, as join marks will show, when dry. Each coat must be dry before applying the next. Leaving the surface to dry overnight is usually sufficient.

Six coats or more should be applied to create a relatively smooth, visually uniform surface.

On external render, limewash used to be mixed with tallow, a type of animal fat. This produced a water droplet resistant but vapour permeable surface, which aided weathering. Nowadays, casein is often used, which aids vapour permeability, but has the added advantage of reducing dusting of the surface.

If a colour is required to finish the surface, pigmented limewash can be applied on the last two coats. Alternatively, in order to achieve a uniformly flat, deep colour, all six coats could be applied with pigment.

As limewash is slightly caustic, goggles and gloves should be used when painting, and all furniture and carpets should be covered over, or removed from a room.

Alternatively, for internal plaster distemper can be used. This is a water-based dispersion of inorganic pigments (primarily titanium dioxide) in a glue or caesin and linseed binder.

Today, limewash and distemper can be purchased from suppliers ready-mixed in a range of colours.

NOTE

Modern paints such as emulsions do not adhere well to lime plaster and can peel soon after application. They have reduced vapour permeability and huge expansion co-efficients, which means they expand and crack, allowing rainwater to percolate behind. This is then trapped, and results in peeling.

Historic buildings

Plaster and Render

Further information

Click on the website address for link

References

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Eccesiastical Architects and Surveyors association

Lime in Building by **Scofield, J**
Black Dog Press

Mortars, Plasters and Renders: by **Ashurst, J & N** English Heritage Technical Handbook 3

The Use of Gypsum Plasters The Building Conservation Directory, (BCD) by **Ratcliffe, T**
Cathedral Communications 1997

Awash with colour (BCD) by **Bennett, B**
Cathedral Communications 1997

Vapour Permeable Paint (BCD) - by **Davies, G**
Cathedral Communications 1996

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37 Spital Square London E1 6DY
0207 377 1644
info@spab.org.uk
www. spab.org.uk

English Heritage
1 Waterhouse Square 138-142 Holborn London EC1N 2ST
0207 973 3000
www.english-heritage.org.uk

Georgian Group
6 Fitzroy Square London W1T 5DX
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www.georgiangroup.org.uk

Victorian Society
1 Priory Gardens Bedford Park London W4 1TT
0208 994 1019
admin@victoriansociety.org.uk
www.victoriansociety.org.uk

Specialist suppliers:

KEY:
LM - Lime (Hydraulic and non-hydraulic)
LW - Limewash
L - Lath (Riven and sawn)
D - Distemper
A - Analyisis of plaster sample
SC - Specialist contractor
C - Course in plastering

The Lime Centre - LM, LW, L, A, C
01962 713636
www.thelimecentre.co.uk

Mike Wye & Associates - LM, LW, L, C
01409 281644
www.mikewye.co.uk

Old House Store - LM, LW, L, SC, C
0118 969 7711
www.oldhousestore.co.uk

Farrow and Ball Ltd - LW, D
01202 876141
www.farrow-ball.co.uk

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If you require further information about any of the issues raised in this leaflet or any other building conservation matters, please contact the Building Conservation Officer at

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Tel: (01590) 646658
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