INFORM

PLAIN LIME PLASTERING

HISTORIC ENVIRONMENT SCOTLAND | ÀRAINNEACHD EACHDRAIDHEIL ALBA

Fig. 1 Slaking quicklime to produce lime putty.

Fig. 2 Matured lime putty for use in traditional plastering.

PLAIN LIME PLASTER

Plaster has a long history of use as a finishing material for internal walls and celings in Scotland. The two main methods of using lime plaster are applying it directly onto masonry, commonly referred to as 'plaster on the hard,' or onto a backing of timber laths. This INFORM provides information on the materials, preparation and application of plain lime plaster, as well as considerations for repairs.

Materials

Lime

The most commonly used binder for plaster in traditional buildings is lime. Lime plaster is a vapour-permeable finish which allows the transfer of moisture and contributes to the breathability of solid masonry walls. This aids the overall health of a building by reducing the risk of condensation and damp.

Traditionally, most lime used for internal plastering would have been non-hydraulic, also known as 'air lime'. Lime is produced by burning limestone in a kiln to produce a highly reactive material known as quicklime. This is 'slaked' with water (Fig. 1) and sieved to produce lime putty. It is then left to mature for a minimum of three months before use (Fig. 2).

Alternatively, quicklime can be combined with damp sand, commonly referred to as 'hot mixing', and left to mature before being 'knocked up' for plastering. 'Builder's lime', supplied as a powder, can be soaked to produce a putty, but is generally considered an inferior product that is not suitable for the repair of traditional plasterwork. Non-hydraulic lime putty-based plasters are still considered the most appropriate material for repairing traditional plasterwork.

Sand and aggregates

Matured lime putty is mixed with clean, well graded sharp sand (passing a 3-5mm sieve) to form 'coarse stuff', used for backing coats, or with fine sand (passing a 1mm sieve) to form 'setting stuff,' for finishing coats (Fig. 3).

Hair

Animal hair is added to plaster to improve tensile strength and prevent shrinkage cracking (Fig. 4). It is readily available from lime suppliers.

Fig. 3 Well graded sharp sand (left) for backing coats and fine sand (right) for finishing coats.

Hair should only be incorporated into the plaster immediately before use. If added too soon, it will degrade during the mixing process. It should be evenly distributed into the mix until there is a 'beard' of hairs (spaced approximately 1-2mm apart) around the edge of a trowel when lifted from the batch (Fig. 5). The use of synthetic hair alternatives is not appropriate for traditional plasterwork.

Gypsum

Gypsum, or Plaster of Paris, was sometimes added in small amounts (or 'gauged'), to traditional lime plasters to accelerate setting times, especially for small scale repair work. There is evidence for the use of gypsum in Scotland since the early 16th century, and it was used increasingly from the 18th century in decorative plasterwork schemes. However, since the mid-20th century, gypsum based plasters have superseded lime-based plasters in new-build construction.

Modern plasterwork is applied in the form of plasterboard and lightweight plasters which have shorter setting times than traditional plasters. Lime and gypsum have different properties and where repairs are being carried out to traditional plasterwork the use of modern gypsum plaster products alone is likely to be inappropriate. However, the addition of small amounts of gypsum (now sold as 'casting plaster') to lime plaster may be appropriate for small patch repairs.

Plaster mixes

Coarse stuff, used for applying backing coats, typically comprises one part lime putty to two parts coarse sand by volume (with the addition of hair), while setting stuff for finishing coats comprises equal parts lime putty

Fig. 4 Bundle of hair for mixing into plaster.

Fig. 5 Hair should be evenly distributed through the mix, appearing as a 'beard' of hairs on the trowel.

Fig. 6 New riven lath butt jointed and staggered.

and fine sand. Enough water should be added to the mix to allow the plaster to be easily worked and coated to the desired depth without the application of too much pressure, which can damage backing coats, particularly on lath backgrounds.

Lath

Timber laths on walls and ceilings were traditionally produced from straight grained timber, split (or 'riven') into narrow strips. Split lath is considered superior to sawn lath because timber split along the grain is stronger and less prone to failure.

Replacement laths should match the original as closely as possible and be spaced approximately 8-10mm apart. The ends should be butt jointed and nailed on a supporting timber with the joints staggered at regular intervals of between 600 and 900mm to minimise cracking (Fig. 6). Plaster repairs can be undertaken to existing laths providing they are in good condition (Fig. 7).

Fig. 7 Timber laths ready for application of first coat.

Preparation

Reinstatement or repair work should match the original, using the same materials, number of coats and methods of application. Backgrounds should be prepared prior to application to reduce the risk of premature failure.

Solid backgrounds, especially those which are dry and porous, should be free of dust and loose debris and well dampened to control the rate of

Fig. 8 A wall being 'dubbed out.'
(Photo credit: Scottish Lime Centre Trust)

Fig. 9 Plaster nibs or rivets formed on the back side of the lath.

suction and avoid loss of bond and rapid drying. Walls should be in good condition, with hollow areas 'dubbed out' (made roughly flush) with haired coarse stuff (Fig. 8). Where necessary, deeper voids should be re-pointed and filled with pinning stones to provide a reasonably flat and consistent background for the plaster. Lath backgrounds should be free of dust and debris and dampened before new plaster is applied.

Fig. 10 Scratching first coat plaster with a lath scratch.

Application

First coat

Once backgrounds have been prepared and dampened, the first coat of haired coarse stuff should be applied to a depth of approximately 9-12 mm. When applying onto a lath background, it is important that the plaster penetrates the gaps sufficiently to form nibs or rivets on the rear of the laths, to ensure a good bond to form a base for subsequent coats (Fig. 9).

The first coat should be scratched with a lath scratch to provide a mechanical key for the straightening coat. To minimise the risk of cracking it is important not to penetrate the full depth of the first coat when scratching. On lath, the first coat should be scratched diagonally, not parallel with the spaces in the lath (Fig. 10). The first coat should be allowed to fully dry out, with any initial cracking pressed back and re-worked. The rate of drying is controlled by minimising draughts and

fine misting to prevent rapid drying which can weaken lime plasterwork.

Straightening coat
After dampening the first coat, the 'straightening coat' of haired coarse stuff is applied to a depth of approximately 9-12mm. It is then ruled straight and floated (or scoured) with a devil float (which has a protruding nail to lightly scratch the surface) to provide a flat and lightly keyed background for the finishing coat (Fig. 11). In some cases, especially in vernacular work, plaster finishes were simply straightened by eye, but in most cases plasterwork was straightened to line and level. Any shrinkage cracking should be re-worked and floated, with measures taken to prevent rapid drying before application of the finishing coat.

Finishing coat
Before applying the finishing coat, backgrounds should be dampened and setting stuff applied in two or three thin coats in quick succession to an overall depth of around 2-3mm. The plaster should then be lightly wetted and floated with a timber float as it begins to set and then polished with a steel trowel as it sets to a hardened finish. In the hours and days after application, further wetting, scouring and polishing may be required to control shrinkage cracking and crazing (fine webs of cracks) in the finished work.

Common defects

Water damage
A major cause of defects in plasterwork is water ingress caused by external defects or plumbing failure. Water penetration into plasterwork can cause staining, distortion and mould growth if not addressed. Ultimately it may lead to plaster becoming detached from its background and collapsing. The cause of the water ingress must be addressed before repair work to the plaster takes place. The backgrounds must also be dried and made good.

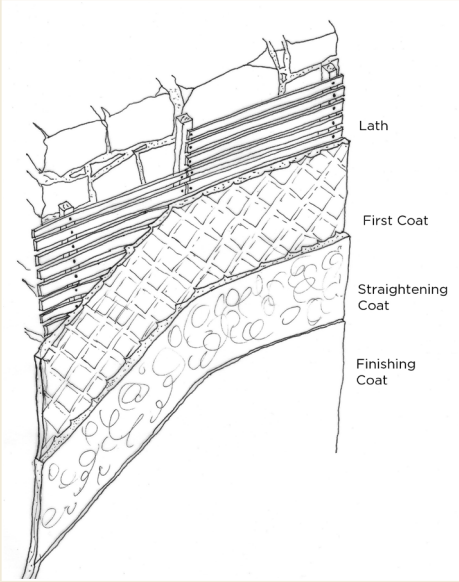

Fig. 11 Sketch of plaster application onto lath.

Separation and collapse
This is often caused by a lack or loss of key between coats, which can be due to structural movement, vibration, excessive loading, accidental damage caused during service installations, or timber decay as a result of penetrating damp (Fig. 12). Lath ceilings are particularly at risk if the plaster rivets formed by the first coat have been damaged or compromised by the laths being insufficiently spaced apart. Failure to adequately prepare backgrounds, control suction, adequately scratch between coats and the use of strong coatings over weaker backgrounds can also cause separation. Separation often leads to the plaster bulging and will eventually result in collapse.

Fig. 12 Collapse can be caused by loss of bond between coats, structural movement and the effects of long term penetrating dampness.

Cracking

Cracking is commonly a result of structural issues or excessive loading, differential movement between dissimilar materials (including inappropriately specified repair mixes) and inadequately staggered jointing in lathwork. Workmanship issues caused by poor background preparation and aftercare can also cause cracking, crazing and friability of finished work.

Repair approach

Once the cause of failure has been identified and rectified, repairs should be carried out following the principles described above, ensuring that the backgrounds are free of dust and dampened to control suction.

Loose and unstable areas of plasterwork can be preserved by screwing or fixing them to supporting timbers behind, consolidating them to minimise loss of original work. If patch repairs are decided upon, surrounding work should be cut back to a sound face with a slight undercut to improve the bond between old and new (Figs. 13-15).

Repair mixes

Mixes for plaster repair and reinstatement work should match the original plaster, ideally analysing the original to identify the type and grading of the aggregate, mix proportions and presence of additives such as hair and gypsum. Repair mixes should be applied in thin coats, sufficiently keyed and prevented from drying out too quickly. Fine cracks, small holes and minor imperfections can be filled using proprietary fillers mixed with crushed chalk (whiting) to reduce the strength of the mix, and sanded flush.

The addition of small quantities of gypsum for repair work can reduce the risk of shrinkage. However, gauging with gypsum can vary the suction of the finishing coat and affect the appearance of decorative surface finishes such as limewash and distemper. It is important to remember that hairline cracks can open and close through the seasons with changes in moisture levels and temperature; these usually do not require repair.

Fig. 13 Loose plaster removed from cracked section of plasterwork. (photo credit: Darren McLean)

Fig. 14 First coat of coarse plaster for patch repair. (photo credit: Darren McLean)

Fig. 15 Finishing coat applied to patch repairs. (photo credit: Darren McLean)

Insulated lime plaster

Where plasterwork is being renewed it may be possible in some cases to apply insulated lime plaster. This type of plaster can provide an improvement in the building's energy efficiency and thermal comfort whilst maintaining breathability.

Insulated lime plaster is usually applied at a depth of 50-80mm, considerably thicker than a traditional plaster. For this reason, insulated plaster is not normally appropriate for use in buildings with historic or decorative finishes such as cornices or mouldings.

Conclusion

Plain plasterwork is an important element of traditional and historic interiors and should be repaired on a like-for-like basis. Lime plasters buffer moisture, allowing masonry buildings to breathe and maintain a stable internal environment. They are resilient, and can often survive stress and water damage better than modern plasters. This allows repairs to be undertaken rather than wholesale replacement.

If executed correctly, lime plaster can be repaired durably and economically, with minimal loss of original material. Specifying traditional lime plaster repairs helps to conserve the character and appearance of traditional buildings and helps encourage the retention of traditional skills.

Further reading

Technical Advice Note 2: Conservation of Plasterwork, Historic Scotland, 2002.

Technical Advice Note 26: Care and Conservation of 17th-Century Plasterwork in Scotland, Historic Scotland, 2016.

Plastering Plain and Decorative (4th Ed.). Millar W. & Bankart G., Donhead, republished 2009.

Practical Building Conservation: Mortars, Renders and Plasters, English Heritage, 2011.

Further information

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Cover image: *Applying lime plaster to lath.*

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