Foreword

This series of booklets has been produced by the Department of the Environment to increase awareness of the value of our architectural heritage and to provide information on the basic principles and methods of conservation and restoration. The titles in the series are listed on the back of each booklet.

These texts are not intended to be comprehensive technical or legal guides. The main aim is to assist architects, builders, owners and others,in understanding the guiding principles of conservation and restoration. They will facilitate the identification of the most common problems encountered in heritage buildings,and indicate the best solutions. It should be appreciated that specialised aspects of conservation and restoration will require professional expertise and more detailed information.

The Department acknowledges,with appreciation,the efforts of the authors of the individual booklets,the Irish Georgian Society who coordinated their production,the Conservation Advisory Panel established under the Operational Programme for Local Urban and Rural Development and all others involved.

Summary of Conservation Principles

- Research prior to planning work
- Minimum intervention - repair rather than replace
- Respect the setting.

Summary of Conservation Procedure

- Research and analyse history of building
- Survey building and identify original material
- Plan work according to conservation principles
- Use experts where necessary
- Record all work
- Install maintenance procedures.

Introduction

This booklet is intended as a guide for those engaged in the preparation of mortars for bedding and pointing,and in the preparation and application of renders. A comprehensive study is not possible because of limited space. It is however intended that the information included will create an awareness and understanding,and enable the achievement of good work. Experience and practice, together with a knowledge of traditional structures,are also essential prerequisites for a successful project.

Everyone involved in carrying out work on historic buildings/structures should have an understanding of their structural needs. Whether it be an important public or ecclesiastical building,large house or cottage or simply a wall,traditional structures built of stone or brick and mortar, rendered or unrendered, have needs which differ from the requirements of modern structures,which have expansion joints and damp proof courses. Recognition of this is fundamental to their continued wellbeing. All too often the employment of incorrect and inappropriate methods results in a great deal of damage, both aesthetically and technically.

Traditional buildings require flexibility to allow for the independent movement of their constituent parts,to cope with seasonal changes and to allow for any moisture entering walls to evaporate unimpeded. Stone and brick must be given the conditions required to give a satisfactory life. Mortars, plasters and renders have a major role to play in this respect. Mortars and plasters must be pliable and porous,not hard and impermeable. The most important material in achieving pliability is lime and yet this material,so essential to proper practice, is only minimally used nowadays.

Brief History

In Ireland the use of lime in buildings goes back many centuries and continued up to relatively recently, with its preparation and use still living in the memory of some builders. The legacy of old lime kilns throughout the country bears witness to the widespread preparation of lime. Medieval lime mortars still survive in many structures, together with remnants of plasterwork.

Lime mortars had been perfected by the Romans, whose expertise spread to conquered territories, including Britain. Using pozzolanic materials such as volcanic ash, they found that an hydraulic set could be achieved. This allowed mortar to set under water. The term pozzolana, commonly used to describe materials which give an hydraulic set, derives from the area near Naples in Italy where large deposits of volcanic ash were to be found.

Today modern pozzolanic additives which can achieve a chemical set are materials such as HTI (high temperature insulation), PFA (pulverised fuel ash), brick dust and Portland cement. HTI is a white powder. PFA is greyish in colour. For mortar making the additive must be low in sulphate and, since its pozzolanic make up can vary, it must be chosen to suit the particular job on hand. Other additives used to strengthen mortar were seashells and ox hair and sometimes chopped straw in vernacular buildings. Animal blood and urine were used to increase plasticity.

Lime mortars were in universal use up to the late 18th and early 19th centuries when experiments resulted in the development of cements for mortars and rendering. Roman cement, used for renders, was patented at the end of the 18th century and Portland cement was developed during the 19th century. These materials speeded up building work. Their production continued to develop, resulting, unfortunately, in the widespread use of cement products in traditional/historic buildings, to the eventual almost exclusion of lime.

In vernacular buildings lime mortars and renders were used where lime was available. In north western and western coastal areas of Ireland dry wall building was common. Joints in these areas were sometimes mortar filled at a later stage. Lime washes were used on many vernacular structures throughout the country.

Disused limekiln.

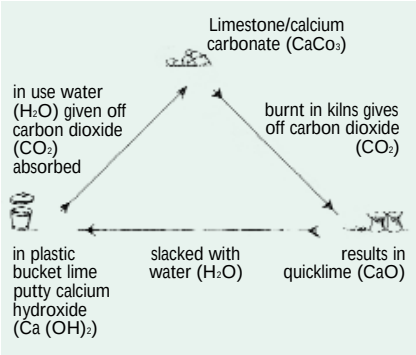
Typical Elements

Materials and their Preparation

Mortars and renders are produced from lime, sand (pastes and binders) and water, and the quality of each material is important to the final results.

Lime

Lime is made from limestones fired in kilns at high temperatures of approximately 1,000 degrees centigrade. The resultant dry material is quick lime. When slaked with water, lime putty or lump lime is produced. Slaking is carried out by adding the lime to the water in suitable galvanised containers. Heated water can assist the process. The putty is then sieved through a 5 mm sieve in order to remove any unburnt particles and is kept under a covering of the slaking water and allowed to mature for as long as possible, thus improving its plasticity. When ready for use it should be beaten up and mixed to render it workable. If left exposed to the air the surface hardens to become limestone again,thus completing what is known as the lime cycle.



The lime cycle

Lime putty is available from a small number of suppliers in this country, and there is a form of putty which is manufactured through an industrial process and which can be bought in tubs. The latter differs from traditionally prepared putty, being factory produced, but is,however, a useful substitute. Lime can also be prepared from hydrated lime sold in bags as a dry powder. This must be thoroughly dry and fresh and can be prepared similarly to quicklime, i.e. slaked and allowed to mature.

Coarse Stuff

Lime putty can be mixed with sand/ aggregate, traditionally in the proportions of 1:3,to produce 'coarse stuff',using mechanical mixers or by hand. This must also be allowed to mature for as long as possible and can be stored in plastic containers, covered with wet sacks and airtight lids. This can be used as it is - or with the addition of ox or goat hair - in undercoats but it will be slow to set and acquire strength. Frost action will be detrimental to results. The surface of work carbonates as it gains strength.

If setting agents are to be used,these must not be added until immediately prior to building work. When ready, the required amount of coarse stuff is mixed with the required proportion of setting agent.

Mortar Mixes

Mix lime and sand (coarse stuff) and allow to mature.

	Lime	:	Sand
A.	1	:	6
B.	1	:	4
C.	1	:	4
D.	1	:	4

Add the appropriate proportion of cement to coarse stuff immediately before use.

Final Mix

	Cement	:	Lime	:	Sand
A.	1	:	1	:	6
B.	1	:	2	:	8
C.	1	:	3	:	12
D.	1	:	6	:	24

The above chart ranges from stronger to weaker mixes from top to bottom.Mixes depend on the strength of background material and levels of site exposure. On weak backgrounds, weaker mixes should be used. Stronger backgrounds can take stronger mixes. Experience plays a big part in choosing correct mix.Animal hair can be added to undercoats.

A and B are used on backgrounds of good durability and above moderate exposure.
C and D are used on backgrounds of moderate durability and moderate exposure.

	Lime	:	Pozzolana PFA or Brick Dust	:	Aggregate
E.	2	:	1/2 or 2	:	5
F.	1	:	1/4 or 2	:	1
G.	1	:		:	1

E. External walls in moderate exposure and of average to lower durability.
F & G. Fine ashlar joints or gauged brickwork

Note: Pozzolanic materials will affect the final colour of the mortar.

Mixes of cement,sand and plasticiser, and of masonry cement and sand are useful for the repair of unpainted Roman cement.This sometimes has crushed glass added to give sparkle.

Sand/Aggregate

Clean, well washed sand must be used. This must be sharp sand,that is, ranging from fine to coarse, and graded in accordance with Irish Standard/British Standard requirements. The colour of sand is a determining factor in the colour of mortar produced. In as far as possible efforts should be made to match the colour of new mortars with those existing. The addition of colourants is not satisfactory since consistency of colour is difficult to achieve and results can be blotchy. They should be avoided where possible.

Hair

Ox or goat hair, thoroughly clean and well tested,of approx.50 mm-75 mm in length should be well mixed into the coarse stuff to give added strength.The amount used is approximately 6-8 kilos per cubic metre.

Water

This must be clean. The thorough beating and mixing of lime putty/coarse stuff increases pliability and the addition of water should be kept to the minimum necessary.

Common Problems and Solutions

Problems in mortars and renders are less likely to arise as a result of poor early workmanship or materials,than through defects caused by neglect. Most defects stem from water entering from roofs,broken gutters and downpipes. Inappropriate repairs using incorrect methods and materials exacerbate problems they set out to correct.

1. Decayed pointing

Decayed and loose pointing, together with joints which have become empty, allow water to penetrate into the walls and lodge there, thus setting up erosion and causing crumbling of arrises.

The decayed pointing should be renewed.

2. Organic growth

The roots of ivy growth can penetrate into joints and undermine them. Moss and organic growth can hold in moisture.

Ivy should be very carefully removed prior to any repointing and the organic growth treated with an approved biocide.

3. Inappropriate pointing

Raised pointing,unfortunately all too commonly seen,is aesthetically very disfiguring and more seriously, it allows water to lodge on top thus setting up decay in the masonry or brickwork.

To avoid future problems the wall may have to be repointed.

Repointing

General

Walls which are being considered for repointing must be examined carefully. Very often total repointing will be unnecessary since original work will be sound. Only areas where mortar is found to be loose and decayed or where joints are open need to be redone.

The authenticity of original work,as an important part of the overall structure, is a factor to be taken into account in decision making. Where partial pointing is to take place, every attempt must be made to ensure the new finished work blends in with the old. Serious damage is done both visually and technically, by using inappropriate materials and by bad pointing.

Mortar joints must never be stronger than the stone or brickwork surrounding them. Joints should be seen as having a sacrificial role, accepting weathering and not forcing it elsewhere.

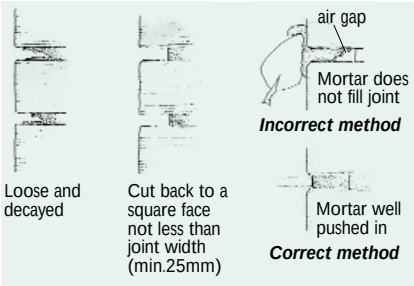
Care must be taken to maintain existing joint widths in repointing. Joints in rubble work will generally be wider than those where stones are of regular dimensions.

Originally, bedding and pointing are likely to have taken place in one operation. The surfaces of joints may have decayed over time - due to frost action at an early stage on the mortar before it had time to set fully - thus leaving arrises of stones vulnerable to weathering. This is often the case with medieval/early work.

Example of bad pointing.

Procedure

Carefully remove decayed mortar back to a square face by using implements which fit into the joint (improvise if necessary),to a minimum depth of 25 mm and not less than the depth of the joint. Avoid using angle grinders and wedge shaped chisels. Great care should be exercised where power tools are used. These should be used only on regularly coursed work and then only by experienced operatives. Where joints are very fine great care must be exercised to avoid altering their appearance. All too often implements used to remove decayed mortar result in damage to stones and widening of joints. Fine joints are raked out using flat steel tools,a jointing tool,or hacksaw blades. Brush out all dust from the joints and rinse with water if necessary. Before pointing ensure that joints are wetted to avoid suction of water from mortar.



Raking out joints

When filling the joint it is important to use tools that will push the mortar well into the joint so that it is fully filled leaving no air gaps.

Pointing irons and tools which are improvised to suit each situation can be used. In the case of rubblework where arrises have worn, repointing must be carried out in a manner which allows the stones to read,and the joints should be weather struck. In regular work,where arrises are even,joints should be flush filled. Surfaces should be finished as far as possible to match existing surfaces which will have weathered. This involves dabbing with a brush,or rubbing with cloth or spraying with water before the mortar dries to expose some of the aggregate. It may be necessary to spray joints of finished work to prevent them drying out too quickly.

Brick joints should be flush filled or brought only slightly back from the face and can be curved. Gauged brickwork should be treated similarly to fine ashlar joints. In tuck pointing, the joint is filled with mortar coloured to match the bricks. This is scored to receive the tuck which consists of white lime putty. This method of pointing gives the impression of regular shaped bricks and exact joints.

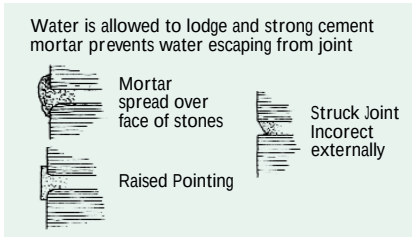
Tuck pointing

In gauged brickwork and fine ashlar work, joints are very close and almost indiscernible. Filling them properly requires careful work. Mortar can be introduced as a sandwich between sheets of clingfilm from which it is pushed into the joints using an appropriate tool thus keeping surround stones clean. The stone faces of fine work can also be protected when repointing by the use of masking tape which can be fixed over the joints and cut along joint lines before filling.

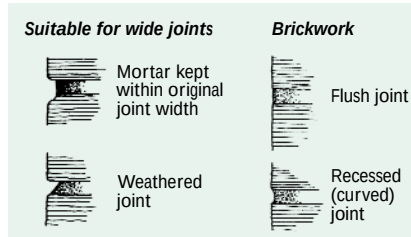
Lime and fine sand or lime putty can be used for repointing fine joints.

Safety

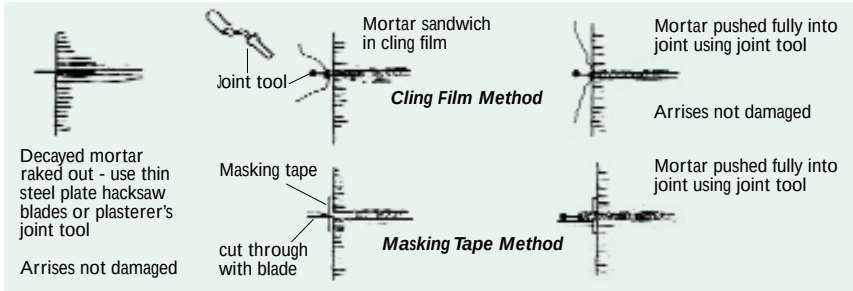
Care must be taken when preparing and using lime. Protective clothing,gloves and goggles must be worn and masks must be used when using fine materials and additives to avoid inhalation. Manufacturers'instructions must always be followed.If the necessary precautions are taken lime can be used safely.



Incorrect pointing



Correct pointing



Fine Ashlar work

Ashlar

Crude pointing and repair

Pleasing pointing

RENDERS

Introduction

Renders are external coatings applied to buildings. As with mortars for bedding and pointing,these must allow for flexibility and the evaporation of water. In Ireland,apart from major public and ecclesiastical buildings, whose exteriors are often of exposed ashlar stonework,the most common external finishes to buildings are renders applied to rubble stone walls. This finish,in its varying forms,gives an overall sculptural effect and contributes to the character of buildings of town and countryside. Renders are less expensive to apply than good quality stonework and they often hide poor quality work. They are extremely practical in providing an extra layer of protection while themselves remaining porous. They are also a medium for decoration,both painting and applied modelled/decorative work.

Brief Histor y

Renders commonly used in this country are:

(a) A simple build up of lime washes
(b) Weak/thin coatings used on vernacular buildings
(c) Rough cast which is a wet dash otherwise known as 'harling'
(d) Oil mastic stucco
(e) Lime and cement stucco/Roman cements

a),b) and c) are the oldest form of coatings; d) was developed around the mid-18th century. Various oil mastics were made from mixes of sands,limestone, dust, whiting and powdered pottery. Mixes were gauged with oil immediately prior to application in the form of thin coats to a background pre-coated with linseed oil. The coating was pressed on in suitable widths with a floating tool. These coatings are difficult to distinguish visually from others and only by examination do they become evident. This material was also used for modelling/decorative work; e) was developed towards the end of the 18th century.

There is also applied decoration,in particular to facades in towns and modelled architectural features to door and window surrounds and cornices,adding distinctiveness to individual houses and terraces. Coade stone - an artificial,cast 'stone' - in the form of panels and features was also used. At the end of the 18th century there was much experimentation with various compositions for surface coatings. Roman cement was commonly used, ruled out to give the appearance of stonework. This was often painted but sometimes left unpainted.

The stucco finish of the buildings of many Irish towns,as they stand today, is highly appropriate and imparts an overall uniformity and integrity. Stucco has been described as the most well-mannered finish for town buildings.

Common Problems and Solutions

1. Surface crazing

The use of strong,dense and impervious materials or dirty aggregates, allowing renders to dry too quickly, are among the causes of surface crazing on renders.

The ideal solution is to rerender the wall correctly.

2. Renders separating from their backing

Problems of renders separating from their backing can be due to lack of sufficient key; inadequate control of suction during work; incorrect order of strength of coats applied;and the application of overthick coats.

The wall should be rerendered where necessary. It is better to rerender to straight rather than ragged edges,even if this means removing a little of the sound old render.

3. Rising damp

Walls built up to the mid-19th century - later in some instances - are unlikely to have damp proof courses inserted. This omission can lead to problems of rising dampness which introduces salts, and causes blistering and powdering on surfaces.

Solutions which introduce dense waterproof barriers do not help matters. Water trapped behind impervious renders and joints can set up decay in the stonework/backing material. For details on how to deal with rising damp see booklet No. 11 *Rising damp and timber decay.*

Removal of renders

The all too common practice of removing renders to expose the stonework beneath is most regrettable. Not only is the integrity of a street or terrace visually disrupted at one stroke but the stonework beneath,often of poor visual quality, is incorrectly repointed, then coated with layers of clear impervious "water repellents" thus preventing it from behaving naturally. A most unfortunate aspect of all this is the loss forever of an historic material which today is impossible to reproduce.

The practice is equally disastrous in vernacular buildings. The replacement of their soft lime renders with modern hard regular surfaces also diminishes their charm and character. Bit by bit the distinctive qualities of whole areas are being eroded by such continued inappropriate alterations.

Repairs to Renders

General

The decision to rerender must be made in the same light as decisions for repointing. Only problem areas where plaster is loose and defective need be redone. The retention of sound work is important because of authenticity and historical value. Where problems as already described occur it is important to get to the root cause of these, so that they can be dealt with. This is essential since otherwise repairs will only be of a superficial nature and problems will be likely to recur.

Render must never be stronger than the background to which it is applied. Successive coats must not be thicker or stronger than previous ones and can be weaker. The background and each subsequent coat must be pre-dampened before applying the next to avoid suction. Coats must not be over thick. All organic growth must be treated prior to commencement of work. Carrying out work during frosty or overdry, windy or very sunny periods should be avoided.

Procedure

Cut out defective work to a regular edge, slightly undercutting the top and sides. In ruled out work results will be neater if removal is taken to ruled lines. Ensure an adequate key by raking out joints,scoring background,etc. A mechanical key is more desirable than the use of binding agents,such as PVA. The number of coats to be applied should ensure that the face of finished work comes flush with that existing. Three coat work is usual;the overall thickness of the render usually being a minimum of 25 mm. The first coat is applied to a thickness of say 9 - 16 mm and combed to give a key for the next coat. Remaining coats can be from 6 - 10 mm thick.

In rough cast,the final coat,which is a mix of sharp sand and pebbles,is thrown. If wished, this can be applied in two stages - the first, a butter coat to improve adhesion of the thrown material. The final coat which is thrown from a hawk must be applied carefully to ensure a relatively even surface. Remove and rethrow where aggregate forms clumps.

In ruled out stucco work,lining out is carried out to the finishing coat by the use of a straight edged rule and jointing tool. The heights and widths of lines should match adjacent work or, in the case of new work, dimensions should match similar local work. The final coat should be finished with a wooden float and not overworked. This method can also be used to repair oil mastic renders.

Where stucco is painted,colour matching is not of importance. Where colour of unpainted stucco work must be matched,the use of masonry cement and sand or cement sand and plasticiser may produce a more satisfactory result than mixes with lime. Analysis of existing work may indicate the colour of sands and the use of materials such as crushed glass,etc.,the inclusion of which can improve final results.

House with traditional render

Note on lime

It should be noted that there may be instances where the use of lime would be unsuitable because of incompatibility. For example, it can have a damaging effect on some stone types such as sandstones. Such problems will be discernible on examination, and,if present,indicate that the use of lime should be avoided.

For the vast majority of traditional/historic buildings likely to be dealt with,the use of lime is essential.

Conclusion

Effective and pleasing pointing and rendering are the result of experience and practice, using careful procedures and appropriate tools and materials.

Dos and Don'ts

Do
- use mature lime putty
- use clean sharp sand
- use clean potable water
- work in correct climatic conditions
- ensure appropriate mortar strengths
- ensure clean organic-free backgrounds
- flush fill joints or keep within the original joint widths
- use the correct tools
- match existing or adjacent work when carrying out repairs.

Don't
- use raised pointing
- smear mortar over surface of joints
- use too much water
- use strong portland cement mortars.

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