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Repointing Stone and Brick

(FORMERLY REPOINTING STONEWORK)

1. Historical Note

Repointing of stone or brick walls is often carried out in conjunction with a repair and/or cleaning scheme to a building façade.

It is possibly the most significant element to maintaining the "health" of the wall and enhancing the appearance. The correct repointing can assist in waterproofing and stabilizing the walls of the structure, extend the life of the wall and individual stones and enhance the visual qualities of natural stone walls. The importance of this cannot be overemphasised. Incorrect pointing can seriously reduce the performance of a wall and by implication a building. Water can become trapped behind dense mortar and not evaporate out, physical damage to stone and brick can result from poor work.

The pointing should be subservient to the stone itself and assume a secondary role, visually.

2. *Mortar*

The function of the mortar in the wall is to act as a bedding between stones and varies from fine joints in ashlar stonework to larger joints in rubble masonry walls. Joints are effectively reduced in size by inserting small stones and 'snecked' pieces of stone. Whilst acting as a bedding the mortar must also perform other functions:

i. Prevent water penetration through the joints by its physical presence almost like a masonry' sponge', yet it must allow the wall to breathe and drain, porosity being a key factor in the choice of a repointing mortar.

ii. Be flexible to allow movement/settlement of the structure due to thermal responses and settlement within the structure as many earlier large buildings are not designed with the modern expansion/contraction joints of today.

iii. The strength of the mortar should always be less than the surrounding stones and should be considered as a sacrificial element of the wall, and viewed as a maintenance item in need of replacement possibly every century.

However, the condition of stone walls cannot be viewed in isolation and repointing of any walls will not cure water ingress problems relative to other building failures,

such as gutters, roofs, leadwork, etc, and all must be in good condition to maintain the life of the walling elements.

3. *Common Defects*

All too often repointing is viewed as a cosmetic exercise. When done in a hard cement mortar, which is placed over the existing joint rather than in it, the incorrect pointing sits on the face of the stonework. This method results in a spiders web effect described as 'strap' pointing.

It develops hairline cracks due to the strength of the mix allowing water to penetrate, yet prevents the moisture evaporating due to its density. It usually falls off after 10-15 years, due to lack of preparation of the joints, but sometimes spalls the adjoining stone faces with it.

(illustration)

Another common practice is the slap technique whereby cement mortar is plastered over the joint and stone with a trowel and is usually associated with partial or part pointing of a façade.

Apart from the disfiguring of the stonework, this also prevents the wall from breathing. Due to the adhesion qualities of cement this sometimes prevents its removal and the next stage of repair is replastering due to the damage done.

Repointing should only be carried out if the existing mortar is decayed, cracked or damaged. Sound historic mortar should be untouched. An assessment of *an* existing wall should *clearly indicate where repointing is required. Only in very badly weathered cases should complete repointing be necessary.*

If repointing is necessary, care must be taken to avoid damage and the joints raked out to a 10-12 mm depth and fully packed with mortar using a variety of fine edge pointing irions or tools with the joint being left slightly recessed from the face. Mechanical cutting tools should rarely be used on work to listed buildings as they will damage surrounding masonry. EHS will insist on a sample panel for grant aided work.

4. *Ingredients*

Sand - A variety of sands are available throughout the Province and should be chosen in terms of colour and texture to match original mortar and complement the stone. It should be hard, durable and free from contaminates such as soluble salts.
BS 1199

Water - Should be clean and used for mixing and rinsing of the joints where applicable.
BS 3148

Lime - Lime putty should ideally be used, although bagged hydrated lime is more commonly used, and can be slaked prior to use to increase qualities and improve workability. Lime putty is now available in Northern Ireland and can be supplied as a pre-mixed mortar.
BS 890

Cement – Used to 'gauge' a lime based mortar, particularly in exposed positions, but current best practice is to follow traditional mixes and to avoid its use completely.

Dyes - Rarely used in mortars, natural colours being obtained by using appropriate sands/aggregates any being considered should be oxide based.

Aggregates - As with sands, local varieties are available, small rounded deposits less than 3 mm are often used to give a good bond. Larger particles however may be desirable to match the appearance of a historic mortar. If larger particles are to be included these should be well graded and include a mixture of sharp and rounded grains. Sharp sand gives the best bond but rounded grains are often found in older mortars. All aggregates should be washed and free from impurities.

Moisture Inhibitors. These chemical additives designed for use with cement mixes should never be used with historic buildings. Their purpose is to prevent moisture entering a wall but they also prevent it leaving. While this may be appropriate for a modern cavity wall where moisture can drain out of the cavity, for historic buildings this can contribute to the build up of damp within a wall.

Note on Mixing:

While pure lime work is the recommended technique for the repointing of historic buildings it requires skilled operation and thorough understanding by both the consultant and the contractor. Please refer to 'The Conservation of Scheduled Masonry Monuments' by EHS pages 15 to 19 for detailed guidance.

5. *Mortar Types*

Mortars used on historic buildings fall into a number of distinct types

1.Masonry cement

These mortars are typically 1:4 or 1:5 with sand and should never be used on historic buildings. Their use in the recent past is the source of many damp problems associated with historic buildings today. Were this is encountered a decision will have to be made if it is better to remove the mortar or leave it in- situ. Any decision should be based on an inspection of the condition of the mortar (are hairline cracks allowing water to penetrate?), the damage this may be causing by trapping water and the likely damaged which would be caused by trying to remove it.

2.*Non Hydraulic Mortar based on lime putty*

These mortars are easily worked, they provide a good bond to masonry when cured and are flexible and permeable. This type of lime mortar ('fat lime' free from impurities)

does not have a chemical set and it cures slowly by reaction to air (carbonates). It must therefore be carefully supervised to avoid rapid drying out and can be vulnerable to frost and salt damage during this period. Because of this it is normally only recommended in very sheltered locations. Appropriate mixes depend on conditions and use but often fall within the proportion of 1:3. Pre mixed mortars of this type are available in Northern Ireland.

3. *Artificially Hydraulic Mortars*

These have similar properties to fat lime mortars but there is also a slight chemical or 'hydraulic' set introduced. This acts to strengthen a mortar while the main component carbonates and leaves it less susceptible to early damage. The chemical reaction is introduced by the addition of a reactive aggregate to the mix known as a 'pozzolan'. Brick powder and ash are two common types. Many historic mortars are of this type often because impurities in the production of the mortar introduced some pozzolanic elements. The mortars are stronger than pure lime mixes and therefore have better weathering properties though they may not be appropriate in very exposed conditions. They are often used in the proportion 1:3 to 1:4 where the pozzolan is part of the aggregate. Mortars of this type can also be bought ready made in Northern Ireland. Due to the chemical set, care needs to be taken to follow the manufacturer's instructions.

A second group of these mortars is those gauged with some 'hydraulic lime' to give a chemical set rather than a pozzolan. There has been some controversy over this practice in recent years but if the hydraulic lime and the fat lime are mixed in equal proportion there will be little cause for concern. They can be used in similar exposure conditions.

4. *Hydraulic Mortar based on hydraulic lime*

Hydraulic lime is created from limestones which contain impurities of silica and iron. Because of this they have a chemical reaction as well as carbonation and set in differing degrees of hardness. There are no naturally occurring hydraulic limes produced in Ireland and the majority of this material is imported from France. Their classification is based on strength: NHL2 is also known as 'feely hydraulic', NHL3.5 'moderately hydraulic' and NHL5 'eminently hydraulic' They all have good compressive strength and are flexible and have resistance to frost within 28 days. They are often mixed with sand in the proportion 1:2- 2.5. NHL2 for pointing. NHL5 for severe exposure.

5. *Hydraulic Mortar based on natural cement*

Mortars such as 'Roman Cement' were manufactured during the nineteenth century and preceded the invention of artificial or Portland cement. Ebrington Barracks in Londonderry was originally rendered with this material for example. These mortars have similar properties to artificial cement in that they tend to be very strong and prone to hairline cracks and water retention. There are some modern equivalents but they are rarely applicable in conservation work.

6. *Hydraulic Mortar based upon artificial cement*

Artificial or Portland cement invented in the 1840's has the advantage of quick curing due to its chemical set. Its strength is however much greater than that required for historic buildings and problems result from its Impermeable nature and poor flexibility. Mixes gauged with lime

which maintain the proportion 1:3 have proven to be less damaging than others but with the reintroduction of a wide range of pure lime products in recent years there is no exposure situation were this should be considered the better option. Well executed lime mortars without cement are much better for long term results.

1:1:6 cement lime sand is suitable for severe exposures though it is prone to hairline cracks and needs to be very carefully monitored. The lime and sand are mixed to a 'coarse stuff', and this is gauged with the cement.
1:2:9 cement lime sand is suitable for moderate exposures The sand component can be amended to include a grit aggregate to provide a more robust mortar. Often, this will also give a closer match to an existing mortar.
1:3:12 cement lime sand is suitable for more sheltered exposures.

N.B. The use of very small amounts of cement with a lime mortar can result in failures. Research carried out by English Heritage (Smeaton Report) and Historic Scotland (TAN1) has indicated this. EHS advocates that cement content should never be less than 1:3:12.

6. *Methods*

Rubble Stone Masonry

The process can be considered as 4 stages and it is important that sample panels are executed prior to commencement.

Stage 1
Raking out and removal of old or inappropriate mortar to a minimum depth of 25-40 mm or until sound mortar. Depth of the joint is relative to the width between stones. The exposed joints being cleaned with water or compressed air.

The joint and masonry should then be moistened to ensure water in the mortar is not drawn into the surrounding masonry causing the pointing to dry out too fast
.

Stage 2
Filling of voids and tamping out to provide uniform depth prior to pointing, where necessary. Pinnings can be used to reduce volume of mortar, this is sometimes a decorative feature of a historic mortar and should be reproduced. For pure lime work mortar joints should not be filled more than 15mm at a time and the joints allowed to firm up before the next application. Once complete the joint and stonework should be moistened again as above.

Stage 3
Pointing using previously described mortars. Care needs to be taken to avoid 'laitence' or the creation of a hard outer surface by overworking the pointing and drawing lime

water to the face. After initial set the pointing should be finished of by scraping/brushing to achieve desired appearance and remove residual laitence
.

Stage 4
Protection of the joint and monitoring for a minimum seven day period. Remoistening by spray after 24 hours and working out any hairline cracks. For pure lime work protection is essential to avoid damaging the material during the period it is curing (or hardening) in air and dampened sacks hung in front of a wall are a common solution in hot weather .Pure lime mortars are also vulnerable to frost for at least three months after application. This should be taken into consideration when programming such work.

Work must start at the top of the wall and the activities can normally proceed in an orderly sequence downwards. All joints should be pre-wetted and well filled with the mortar rammed solid and left partially set. (This is usually the following day, however, climatic conditions, mortar type and exposure can vary this). The mortar after initial set is scraped or brushed back to the arrises of the stones creating a slightly 'hungry' joint. This joint can then be washed using low pressure water in order to rinse the brush and remove the debris and expose the aggregate, creating a naturally weathered appearance. Care needs to be taken that water is directed out of the joint.

On most historic buildings a brush finish is appropriate. On some buildings there may be a different historic style such as tuck pointing where a white line of mortar is inserted into a mortar coloured to match surrounding brick to create a more regular appearance. Specific historic styles of pointing should be followed where encountered.

Ashlar Masonry

Ashlar stonework is inevitably finely jointed and repointing requires a fine mortar without grit aggregate. The joints are often so narrow that repointing is unnecessary and any attempt to repoint usually results in some form of inappropriate strap pointing on the surface of the stone, doing consequent damage to the stone.

If repointing is necessary, care must be taken to avoid damage and the joints raked out to a 10-12 mm depth and fully packed with mortar using a variety of fine edge pointing irons or tools with the joint being left slightly recessed from the face. The following outlines the recommended process:

Ashlar Pointing

1. Only those joints where the absence or failure of mortar is adversly affecting stones or walls or where strong sound mortar is causing decay or is visually disruptive should be repointed.

2. Beds where work is agreed should be raked out using hacksaw blades or other similar instruments, the joints should not be widened or the stone damaged as a result of this process and on no account should mechanical disc cutters be permitted on fine ashlar work. The joint should be raked out to a depth of 10-12 mm.

3. Twisted wax string should be inserted along the joint by the hacksaw blade at the 10-12 mm depth.

4. Masking tape should then be placed along each side of the joint to avoid discolouration by action of the lime mortar. The joint should be thoroughly rewetted prior to application of the new pointing material.

5. The mortar should be applied to the joint and pushed in to meet the string backing using a suitably thin implement. Care should be taken that the mortar finishes flush with the ashlar. New mortar should be based on the existing but it is common to find a very rich lime mortar used either pure lime or with a fine aggregate such as 1:1½ lime to white sand (silver silica) or crushed portland stone. Linseed oil was sometimes added historically.

6. After pointing the stone should be cleaned down and all traces of masking tape removed.

7. The joint should be rewetted, kept damp, and protected for at least seven days as normal for pure lime work. Any fine hair cracks noted should be worked over during this period.

Guaged Brickwork

Guaged brickwork is the practice of cutting or rubbing soft bricks to create a very precise fit and is usually employed on historic buildings to provide flat arches over windows or doors. As with ashlar very fine white pure lime with sands and other additives were often employed in these fine joints. Care should be taken to recreate this in any new work following a technique similar to that used for ashlar.

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Environment and Heritage Service
Built Heritage
Protecting Historic Buildings
Waterman House
5-33 Hill Street
BELFAST
BT1 2LA
Tel: 028 9054 3145