LONDON FO GUANG SHAN TEMPLE, MARGARET STREET, LONDON

2.0 METHOD STATEMENT: FOR BRICK REPOINTING

2.1 SCOPE OF WORK

The work described relates to the exposed internal and external brickwork of the property, including rubbed brick arches and existing stone steps.

2.2 CONSERVATION PHILOSOPHY

The intention is not to aim for a “brand new appearance”, but to repair what is damaged, worn or faulty, and to provide it with a finish consistent with a high standard of regular care which should be maintained in the future.

2.3 RECORDING THE WORK

The contractor, or his sub-contractor, shall make a photographic and written record of all work done and materials used, and keep a log of the tradesmen engaged on the work.

2.4 REMOVAL

There must be a presumption against the removal of any item from site without the written approval of the Architect.

2.5 ACCESS

Scaffolding and scaffolding towers will be provided by the Main Contractor, but the sub-contractor should provide ladders, trestles, staging and props as necessary for access and temporary support in the specified work areas. All scaffold pole ends to be covered to protect the building from rust staining.

2.6 The sub-contractor is to make himself fully aware of all the main contractor’s preliminaries with particular reference to Health and Safety.

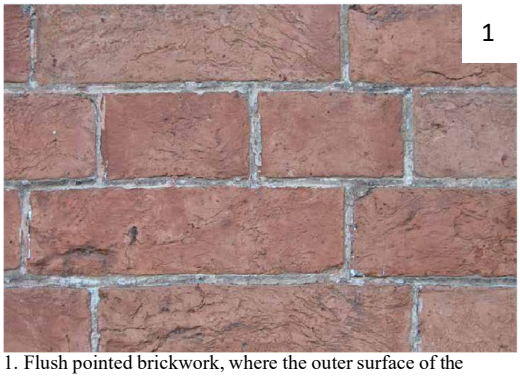
3.0 BACKGROUND

3.1 WHY IS POINTING IMPORTANT?

The mortar joint is not only a key part of the appearance and character of a masonry wall; it also helps to keep the building dry. It does this in two ways: by preventing rainwater finding its way into the core of the wall or even to the inside face of the building though the joints between the bricks or stones; and by allowing moisture already in the wall to dissipate once weather conditions become drier.

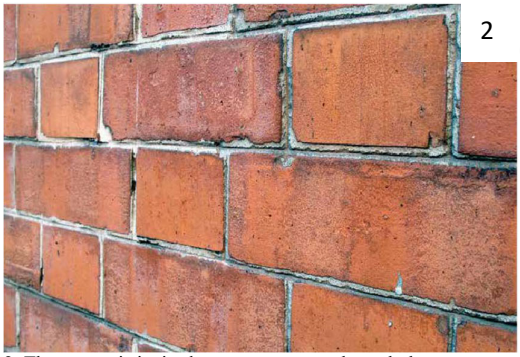
When rainwater hits a building some of it may be absorbed by the stone or brick and the mortar, and some is drawn into the wall via any small cracks between the masonry units and the mortar. To prevent problems occurring, this moisture needs to be able to escape back to the atmosphere once its stops raining. The most effective route for this is through permeable mortar joints. However, if the joints are not able to release moisture, as would occur if hard cement mortar is used, then all moisture movement is concentrated in the bricks or stones, which increases the chance of frost damage or damage due to the crystallisation of soluble salts.

Some of the different styles of joint finish used on historic brickwork



1. Flush pointed brickwork, where the outer surface of the mortar lies flush with the face of the wall. This brickwork shows signs of having been limewashed.

4. The mortar joint has been given a convex V-shaped profile which is referred to as beak or double struck pointing.



2. The mortar is incised so a groove runs through the centre of the joint. This is called penny round or struck pointing.

5. This joint has been indented to form a V–shaped groove which is referred to as keyed pointing.

3. This shows an example of tuck pointing where wide mortar joints between unevenly shaped bricks are coloured to match the brickwork and a narrow 3-5mm joint of lime putty is then placed in scored grooves to create the impression of fine joints and uniform bricks.

6. In gauged pointing fine joints between brickwork, usually in arches are filled with lime putty so that the joint almost disappears.

7. Weather-struck pointing to brickwork. This is slightly proud of the masonry and smoothed off at an angle.

8. Ribbon or strap pointing to brickwork. A style similar to weather-struck being proud of the masonry and smoothed off. Often used to give a regular joint width to irregular brick and stone masonry.

3.2 WHAT IS REPOINTING?

Repointing is the refilling of the outer part of the joints where the previous mortar has weathered away or has been removed because it is unsuitable. Some older brick and stone buildings show signs of having been repointed at different times, often with a variety of mortar mixes and styles.

3.3 WHY IS REPOINTING IMPORTANT?

Repointing can significantly affect not only the look but also the durability of masonry. If done badly or using the wrong materials, it can damage stone and brickwork, sometimes beyond repair.

9. Example of good repointing

The mortar joint has a good colour and texture to complement the brickwork and carefully follows the variable joint widths.

10. Examples of poor repointing

This shows damage to soft brickwork by the use of cement mortar.

3.4 WHY IS REPOINTING NECESSARY?

Masonry walls need to be able to regulate water penetration and evaporation. If the condition of the mortar joints is poor or if the wrong mortar has been used for repointing in the past, then this process can be compromised.

There are three main reasons for repointing:

- Mortar joints are crumbling or loose
- Mortar joints are open or have weathered back to such an extent that the edge of the masonry units are exposed forming a ledge that encourages water to seep into the masonry

- A hard impermeable cement-based mortar (usually grey in colour) has been introduced trapping moisture and accelerating the deterioration of the masonry. Mortar of this type should only be removed *if this can be done without causing even more damage to the adjoining masonry.* The style of repointing may also be visually unsuitable

Repointing is usually only necessary on more exposed parts of a building, low level areas affected by rising damp or areas affected by specific problems such as leaking rainwater goods so sound existing mortar should always be left alone. Lime mortar with some surface loss may still be performing well and if it takes much effort to remove it the chances are that it does not need to be replaced. It may feel a little soft but this may still be acceptable.

Where masonry is clearly decaying it is important to identify the true cause so that the correct remedies can be selected. The pointing itself may not be the cause of the problem so the condition of the whole structure should be reviewed along with the severity of exposure, and any defects contributing to deterioration of the pointing should be remedied before repointing is carried out.

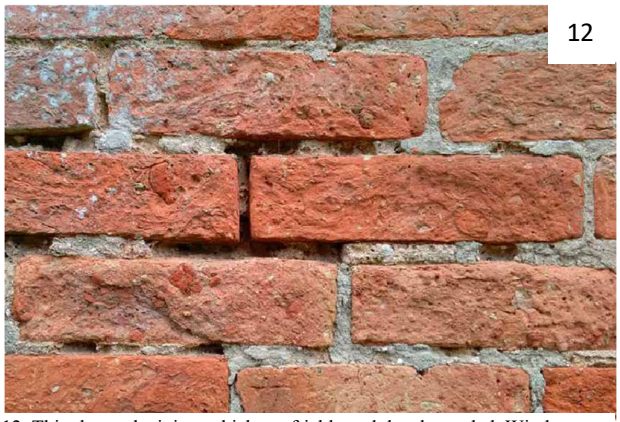
Poor repointing

The pointing on the left has been sloppily carried out which has a significant visual impact not only on the building itself but the wider streetscape.

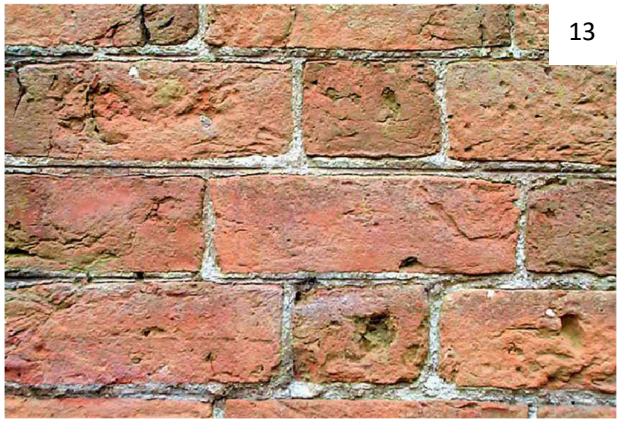
3.5 DOES REPOINTING NEED CONSENT?

For listed buildings or buildings that are scheduled monuments, consent will usually be needed before any repointing is carried out.

11. If a sharp tool can be driven into the surface of a lime mortar joint it does not mean that repointing is necessary. However, if there are open or poorly filled joints that offer no resistance at all then selective repointing will be required.



12. This shows the joints which are friable and deeply eroded. Wind–driven rain can make its way into the core of the wall through open joints.



13. This joint dating from the 18th century shows signs of gradual erosion of the mortar due to weathering, but it is still performing satisfactorily and can be left alone.

4.0 MATERIALS

4.1 MORTAR MIXES AND APPEARANCE

It may be possible to find a sound example of pointing in a sheltered part of the building, for example under the eaves or behind downpipes, particularly on north and east elevations, that is contemporary with the initial construction. For domestic buildings constructed before the early 20th century, this will almost certainly be a lime-based rather than a cement mortar. A close inspection of the mortar will help determine how the joints are finished and whether the aggregate is coarse or fine grained. There may be other additions, such as ash or bits of broken brick or shell that contribute to the character of the mortar. This can then be used as the basis for designing a new mortar and joint finish to match the historic pointing. In choosing an example to copy, care should be taken to ensure that it is not later inappropriate work that is selected.

Patch repointing may initially look clean and bright compared to surrounding original mortar that is retained. Providing the new mortar mix is a good match for the existing mortar it will soon weather and tone down so that the contrast between old and new is less marked.

A mortar mix that is compatible with the permeability of the particular stones or bricks in the wall and suitable for the degree of exposure should be chosen. The key principle is that the mortar should be slightly weaker and more permeable than the stone or brick. Mortar that is less permeable than the masonry, such as most cement-based mortars, will prevent moisture from evaporating out through the joints. Instead moisture will move largely through the stones or bricks, increasing the rate of decay and leaving the hard mortar standing proud.

Mortar that is harder than the masonry is at risk of cracking and causing mechanical damage to the stone of bricks. For this reason, the inclusion of any cement-rich mixes should be avoided. Mixes will vary considerably according to circumstances from pure lime putty with no aggregate to 1-part binder to 3-parts aggregate.

Pointing trial panels:

It is always worth experimenting with various mixes to see which works best in the context. A discreet area should be selected for these to be done. Sample panels can also be used where consent is required prior to the work commencing.

4.2 SAMPLES

Preparation of samples can be a cost-effective way of assessing what mortar mix to use in a particular context. Samples allow everyone involved to agree on the best approach before any work begins and can be left in place as standard that the actual work should meet.

Work involving new mortars on listed buildings or ancient monuments may require a number of sample mortar ‘patties’ or ‘biscuits’ to be made as part of the consent process prior to the work commencing.

Once the samples have been discussed, the mortar mixes that look most suitable should be used to do a trial panel of repointing on the wall. These should be properly finished and allowed to dry so that the final appearance can be judged and a decision can be made on which mortar mix to use.

The strength of mix also needs to be related to the degree of exposure. Areas such as parapets and chimney stacks usually require relatively stronger mixes than more sheltered areas.

If the building to be repointed is of particular significance, for instance it is listed, it may be necessary to accurately match the historic mortar by sending a sample to a specialist in historic mortars for analysis. This will give information on the aggregates and binders used in the original mix which can be used as a guide for the repair mortar.

4.3 TYPES OF LIME

There are two main types of lime that can be used in mortar mixes:

- Non–hydraulic lime
- Natural hydraulic lime (NHL)

4.4 NON-HYDRAULIC LIME

Non-hydraulic lime is the most permeable of all binders. It hardens very slowly by reacting with carbon dioxide in the atmosphere. Non-hydraulic lime mortar has good adhesive properties and can accommodate some movement. It is suitable for repointing in sheltered locations or for use on soft, permeable masonry or brick. Non-hydraulic lime is available in two forms, lime putty and powder:

LIME PUTTY

The best quality non-hydraulic mortars are made from mature lime putty- a stiff whitish coloured paste – which is supplied in sealed plastic tubs. Pre-mixed mortars made with lime putty are also available from specialist suppliers. Lime putty and lime-putty mortars can be stored indefinitely in airtight containers protected from frost.

NON-HYDRAULIC POWDERED LIME (KNOWN AS HYDRATED LIME)

This powdered lime is widely available at builders' merchants and is usually used with sand in cement-based mortars. However, it can also be used to make non-hydraulic lime mortar. Best results are obtained if the lime has recently been manufactured. It can either be mixed with water to make lime putty, which can then be added to aggregate to make mortar, or it can be mixed directly with aggregates and water to produce mortar. The properties of mortar made with powdered non-hydraulic lime and lime putty are similar.

NON-HYDRAULIC LIME WITH HYDRAULIC ADDITIVES (POZZOLANS)

When non-hydraulic lime mortar is mixed with certain additives known as pozzolans (such as finely ground brick dust, for example) it will develop strength more quickly whilst still having a good level of workability. Pozzolanic mortars have slightly less permeability than pure lime putty mortars. Such mortars may be suitable for use in more exposed locations than pure non-hydraulic mortars. Pozzolans should always be added immediately before the mortar is used. Cement is not a suitable additive for lime putty mortar.

4.5 NATURAL HYDRAULIC LIME

Natural hydraulic lime (NHL) is widely available and is supplied as a ground powder that sets by chemical reaction with water as well as by a longer term reaction with carbon dioxide. Its initial set is faster than non-hydraulic lime but the actual rate is dependent on temperature and strength. It is available in three different strengths (NHL2, NHL3.5, NHL5). Hydraulic lime mortars have lower permeability and higher compressive strength compared to non-hydraulic mortars, and may be appropriate for use in locations that are permanently wet or very exposed.

When considering which type of mortar to use, three issues need to be considered by the specifier:

- The type of masonry being repointed – less permeable and denser materials can accommodate stronger mortars, such as hydraulic lime mortars, if extra strength is needed due to exposure.
- The condition of the masonry – masonry that is decayed and highly permeable will require weaker mortar.
- The degree of exposure – areas of high exposure such as a chimney or roof parapet can require stronger mortars.

4.6 AGGREGATES

The aggregate contributes to the colour, texture and performance of lime mortar. There is a wide range of aggregates suitable for making mortar. The most common aggregate used today is sand. Most sands are composed of grains of quartz (silica) but calcareous sand or crushed well-graded limestone is a useful addition to non-hydraulic and pozzolanic mortars as it helps to speed up carbonation. However, fine ‘stone dust’ should be avoided or only added in small quantities to help achieve a particular colour, because if used in large volumes it increases the risk of the mortar shrinking as it dries.

For many general applications nowadays, a well-graded aggregate, containing a range of particle sizes, will be appropriate. The size of the aggregate particles is usually adjusted to suit the width of the mortar joint; coarse grit may be included in a mortar for rubble stonework whereas for the narrow joints of ashlar stone or some brick, fine-grained sand or crushed limestone may be suitable.

Historically, other materials such as crushed chalk, wood and coal ash, crushed shells and crushed brick were also used for making mortar. These materials are available from specialist suppliers and may be needed to create new repair mortars to match the character of existing historic mortars. More detailed information can be found in Historic England’s book on *Practical Building Conservation, Mortars, Renders & Plasters*.

5.0 EXECUTION

5.1 PREPARING THE JOINTS

Once areas of defective pointing have been identified they can be carefully raked out manually using hooked tools or masonry chisels to a depth of at least twice the height of the joint, although on rubble stonework it will often be much deeper than this. On stonework with variable joint widths it will be necessary to decide what the average joint width is.

For the repointing of finely jointed work, such as rubbed brickwork or fine ashlar stonework, which is rarely necessary, a hand-held saw blade is a suitable tool for cleaning out the joint.

Whatever method is used, it is important that mortar is removed from the top and bottom of the joints leaving a square-cut joint. Dust and debris must be removed from the joints using brushes or even a vacuum cleaner and thoroughly rinsed with water so that no loose dry material is left. The masonry must be thoroughly dampened with a hosepipe with a spray nozzle or a pump-action water sprayer, before placing the mortar. This is to reduce suction, improve adhesion of the mortar and prevent the mortar from drying too quickly.

5.2 USE OF POWER TOOLS

The use of power tools, such as angle grinders to remove pointing is not recommended because these do not completely remove old mortar from the joints and can easily damage the face of the masonry. They create a lot of dust so it is very difficult to keep track of where the blade is. However, where there is hard cement rich mortar it may be necessary to use a thin diamond-disc cutter to *very carefully* make an initial breach along the centre of wide joints, so that the loose mortar can then be removed with a hammer and sharp chisel to avoid damage to the corners of the masonry. Alternatively, a masonry drill can be used to drill a line of holes along the centre of the joint which will make it easier to break up the mortar with a hammer and chisel.

Where modern cement pointing needs to be removed, the shallow hard cement mortars tend to crack and loosen as they have no flexibility. They can often be removed with a tungsten-carbide tipped chisel.

5.3 FILLING THE JOINTS

Once preparation work has been completed then filling the joints can start.

Repointing with lime mortars should generally be carried out by an experienced contractor but the skills can be mastered by inexperienced contractors and practically minded homeowners. However, the use of lime mortar is very different to that of cement. It is important therefore to obtain sufficient training before undertaking repointing work using lime mortars. A number of organisations provide practical training work using lime mortars on historic buildings.

Contact with any form of lime can cause severe irritation to skin and eyes. Powdered lime can also cause respiratory irritation. Protection such as face masks, eye protection and gloves should be used when handling lime.

5.4 PROTECTION DURING THE WORKS

Once the repointing is underway it is important to protect it from wind, rain and strong sunlight, to avoid damage or rapid drying. Particular care is required to avoid damage from frost when pointing has to be carried out in cold weather.

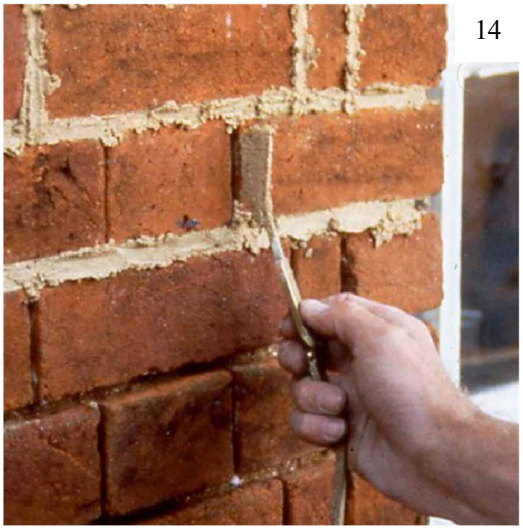
Surfaces should be protected with ventilated covers (multiple layers of hessian, thick blankets or carpet underlay are often used) and regular mist spraying may be needed to maintain damp conditions as the mortar starts to set. Additional plastic sheeting or tarpaulins draped in front of the hessian covers may also be needed if it is very windy or there is driving rain.

5.5 FINISHING THE JOINTS

The mortar is ready for finishing when it is still damp but has a semi-hard leathery consistency so that it can be marked with a thumbnail, and when a thumb pressed into the surface leaves barely any impression.

For joints that are not specially treated a flush finish is usually suitable. Where edges of the masonry are decayed the mortar may be set back to be within the original joint width so as to avoid visually widening the joint. However, this may provide less protection to the stonework or brickwork, so should only be done following an assessment of the condition of the masonry.

BRICK JOINT FILLING



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14. The mortar should be packed firmly into the joint using a pointing iron after all the loose material has been flushed out and the joint wetted first to reduce suction. The inside surfaces of the joint need to be damp but not wet.

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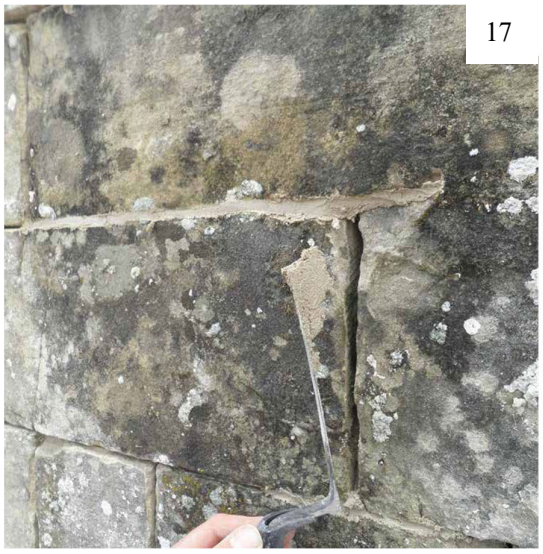
15. The joint should be filled slightly proud of the intended finished level to allow for slight shrinkage and compaction of the mortar as it firms up. Any mortar that is smeared on the masonry should be sponged off with clean water before it has dried.

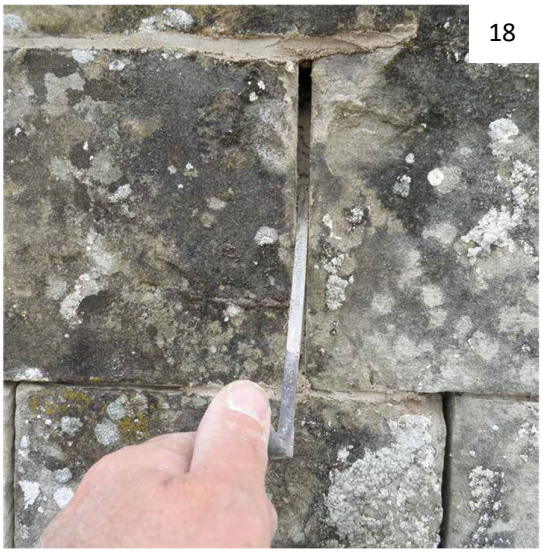
16

16. In masonry which is not finely finished, such as this wide-jointed brickwork, the joint can be finished by hitting the mortar with a bristle churn brush with a firm pushing action. This gives a natural weathered appearance by exposing some of the aggregate in the mortar. The use of the brush also helps to compact the joints and increases the surface area which aids drying. However, it is important the mortar is sufficiently set for this otherwise the brush will leave a series of pin-holes in the mortar.

5.6 REPOINTING REGULAR STONE MASONRY JOINTS



17. A wedge of mortar being inserted into the joint with a pointing iron.

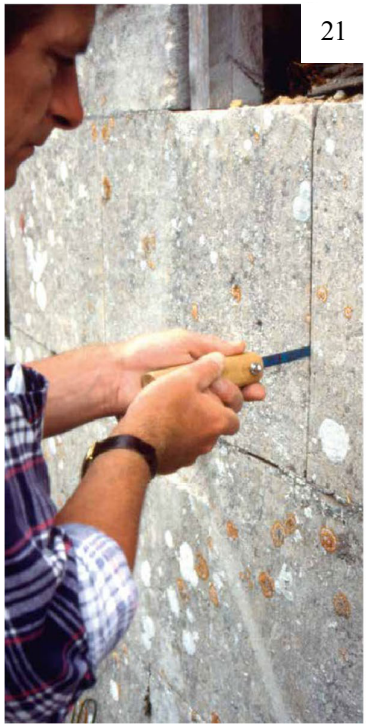


18. Using tools that match the width of the joint allows the mortar to be compacted ensuring a fully filled joint.

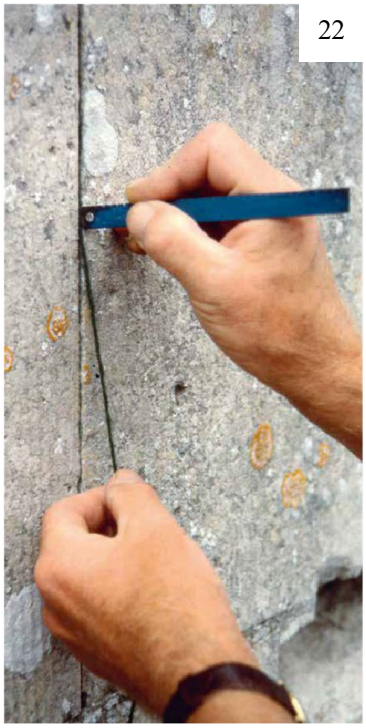
19. The mortar being hit with a stiff bristled churn brush to compact the mortar, remove laitance and expose the aggregate.

20. The finished repointing

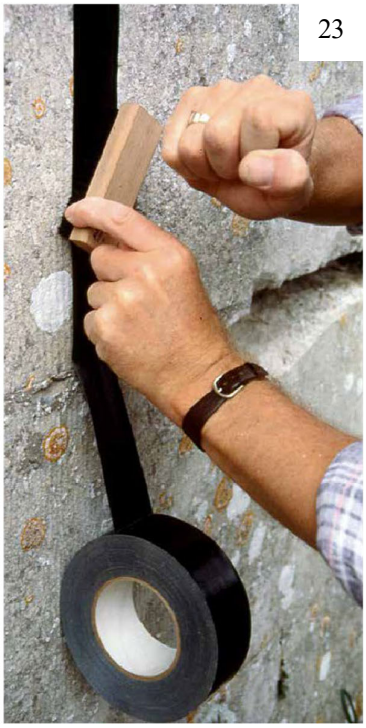
5.7 REPOINTING NARROW ASHLAR JOINTS AND RUBBED BRICK ARCHES



21. Removal of mortar with a hacksaw blade.



22. Insertion of neoprene backing rod into the joint.



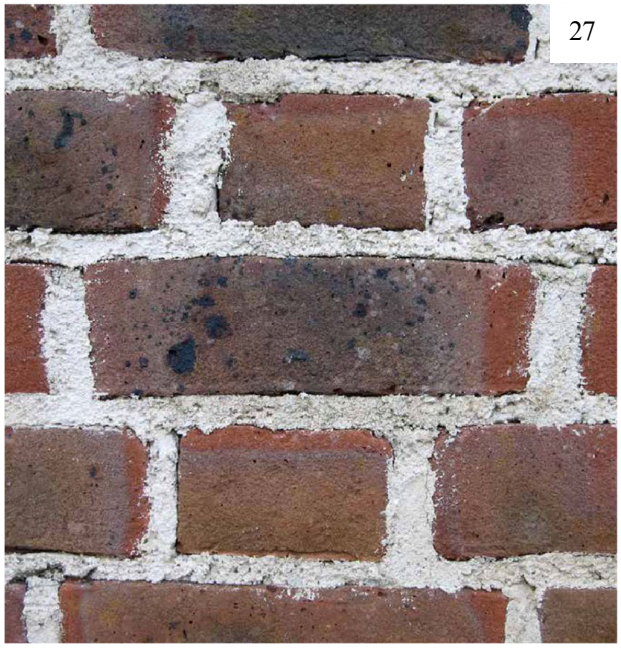
23. Application of plastic faced adhesive tape over the joint to prevent smearing mortar during pointing.

24. Incision of the tape through the joint.

25. Pressing mortar into the joint using a pointing iron.

26. The filled joint after removal of adhesive tape.

5.8 PROBLEMS WITH REPOINTING



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27. This shows a lime mortar which has been applied too wet. It has not been compacted and there is much shrinkage.

5.9 PROTECTION AT COMPLETION

Once the repointing is finished it is important to maintain protection as described in 5.4 until the mortar has cured sufficiently to resist damage by rainfall or frost. The length of time protection is needed depends to a large extent on the weather conditions and type of mortar used. A minimum of a week is recommended but the longer the better particularly in extremes of weather, and for work carried out in the autumn. While all types of mortars will benefit from good aftercare, mortars based on non-hydraulic lime binders need the greatest amount of attention.

6.0 BUILDING WORKS AND EXTENTS:

The London Fo Guang Shan Temple has been extensively repointed on its north and south elevations in a piecemeal fashion since initial construction. Most of this mortar appears to be cementitous and was probably applied during the 20th Century in a (misguided) attempt to mitigate damp ingress. The joints are mostly the weather struck type, with areas of later patching particularly to areas where external pipework was removed and to cracks around arches. Because removing the cementitous mortar will cause more harm than good (knocking off the arises of the bricks) it is proposed to only remove mortar where it is defective, comes loose or is a lighter or grey colour compared to the general. Replacement mortar will be flush, in lime with aggregates and additives to blend the mortar with the surrounding existing as per Section 5 and particularly the method illustrated on page 13.

The boundary and coal cellar walls to the front areas require comprehensive repair. These walls were built of soft red bricks originally laid in soft lime mortar. This been replaced with cement during the 20th Century, which has caused the damp in the wall to evaporate through the brickwork rather than the joints and this has caused severe erosion and 'blowing' of some of the faces of the bricks. Some of those damaged bricks have also been poorly repaired. The cement mortar has also failed and fallen out of many of the joints, with the remainder being slowly forced from the joints and in a friable state.

It will be necessary to repoint these walls in a weak hydraulic lime mortar NHL2 similar to the Temple but using a fine aggregate to match the existing mortar where it survives. This will allow the damp to escape through the pointing instead of through the brick faces.

MORTAR 01: *Temple Brickwork Facades*

AGGREGATE: A well-graded mix of fines, to match the existing in colour and texture to ensure a good blend as far as is practicable.

LIME: It is proposed to use natural hydraulic lime NHL2 in a 1:3 mix of lime to aggregate.

POINTING: Flush brick pointing and not struck as per the existing.

SAMPLE: One metre square sample to be provided to monitor quality and consistency of repointing: *Location to be agreed with Architect.*

MORTAR 02: *Coal Cellar Walls To Front Area*

AGGREGATE: A well-graded mix of fines, to match the existing in colour and texture to ensure a good blend as far as is practicable.

LIME: It is proposed to use natural hydraulic lime NHL2 in a 1:3 mix of lime to aggregate.

POINTING: Flush brick pointing to match the appearance of the existing lime pointing to the wall, where it survives.

SAMPLE: One metre square sample to be provided to monitor quality and consistency of repointing: *Location to be agreed with Architect.*

MORTAR 03*: Stone Copings and Window Jambs and Frames*

AGGREGATE: Fine aggregates, either a fine sand or a crushed limestone.

LIME: Pure fat lime putty.

POINTING: Flush pointing to fine ashlar joints, undertaken by specialist conservator.

SAMPLE: One typical joint to steps and coping: *Locations to be agreed with Architect.*

Acknowledgments: This Method Statement has quoted extensively and in many places verbatim, as well as using the photographic examples, from Historic England 'Repointing Brick and Stone Walls: Guidance for Best Practice', produced in January 2017

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November 2023