INTRODUCTION

PLASTER AND RENDER

Why Repair ?
The Causes of Failure

SALTS AND DESALINATION

Rising Damp
Desalination
Isolating Salts and Masonry

RENDERING

Mix Ratios
Wall Preparation
Dubbing Out
Render Coat
Top Coat or Setting Coat

PATCH REPAIRS

Removal of Rusting Iron
Patch Repairs
Repairing Mouldings

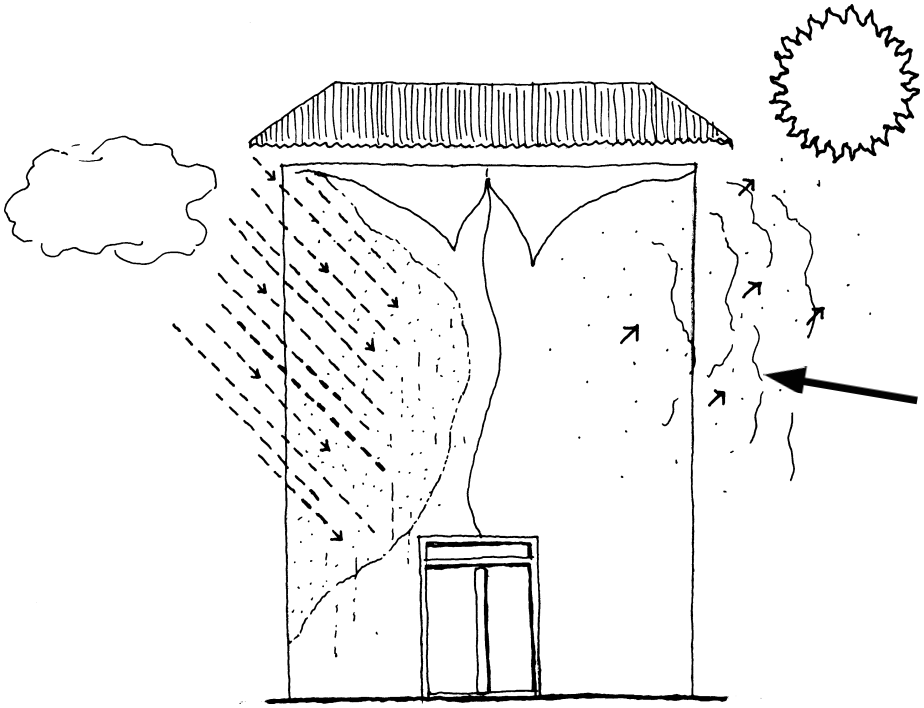
GROUTING AND PINNING

Grouting
Pinning

Note: The procedures described in this section are guidelines only. Before undertaking substantial structural repairs or tackling serious structural problems, consult a building professional.

PLASTER AND RENDER

WHY REPAIR ?



An undamaged and well maintained lime render is essential if walls are to remain strong and the atmosphere inside houses is not to grow dank and humid. Repairing broken or missing rendering should not be seen as a luxury but as a vital step in the repair process that can be guaranteed to deliver important benefits and offer real value for money.

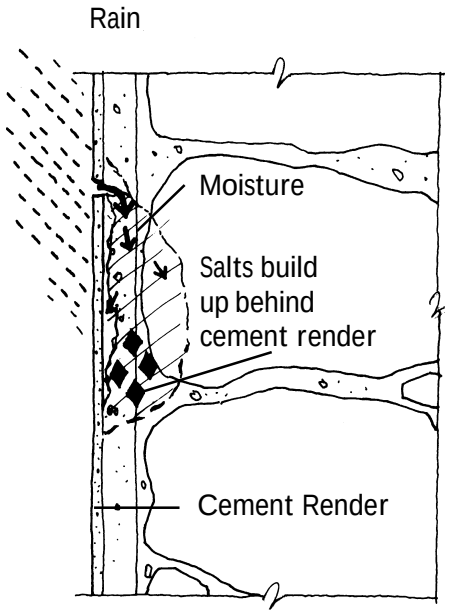
Renders, both interior and exterior, are very easily damaged by:

- **salt action**
- **abrasion**
- **water penetration**
- **neglect**
- **rusting nails**
- **iron**
- **steel fittings**

If the roof of a house is compared to an umbrella, the render is an overcoat keeping out the rain. Lime renders are not waterproof like cement, but porous. They work by ABSORBING rain and holding it in the surface. This prevents the rain from soaking right through and wetting the masonry beneath. When the rain stops and the sun begins to shine again, the rainwater soon evaporates and the render dries.

Cement Render

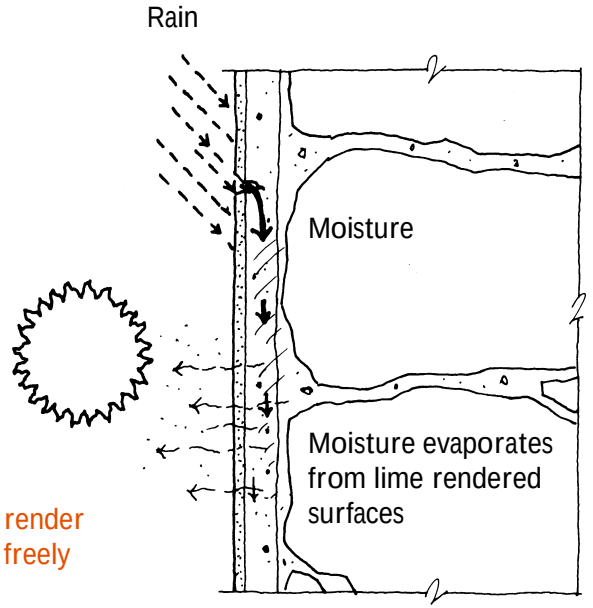
Cement renders work in a different way. They ARE waterproof and do not allow any water to enter. This sounds like a good idea but if the render is cracked or damaged and rain gets in it cannot escape. The wall will remain wet, even if the sun shines all day, water will be trapped inside, evaporating only very slowly. Eventually this causes damage in the form of deep scarring and pitting of the surface. The damage is caused by salt taken up in rainwater as it moves over and through contaminated masonry. As it slowly evaporates out of the small cracks and holes through which it entered, salt crystals are left behind. These grow and begin to push against the stone or mortar around them. Eventually this action will break the mortar and pitting will develop.



Because cement render is waterproof, escaping water cannot pass through it and all the damage takes place in the wall BEHIND the render.

Lime Render

Salts will damage lime render in the same way as a cement render but in this case it is in the face of the RENDER not the wall. So lime renders protect walls by becoming damaged themselves. To safeguard the wall, all that need be done is remove the damaged render from the lower section of wall and replace it with a fresh one and so on.



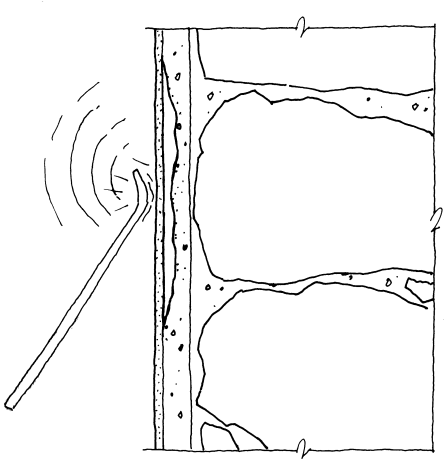
The porous nature of lime render allows water to evaporate freely through it.

THE CAUSES OF FAILURE

It is not sensible to begin a large programme of rendering without first finding out why the render failed in the first place.

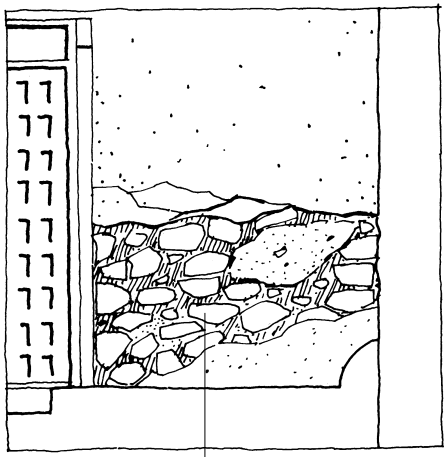
If the cause of the damage is simple abrasion, the result of years of scratching and rubbing by carts and cars, etc., rerendering is strait forward. However, it is likely that the wall will be contaminated with salts of one type or another, in which case rerendering without other supporting treatments would be a terrible waste of money as the new work would quickly fail. To re-render externally without first renewing or repairing gutters and down-pipes etc., would also be a mistake. Just as render protects the wall, gutters and down pipes protect the render.

In the same way as structural repairs, re-rendering and repairs to rendering require careful planning and thought. The first task is to test the surface of the remaining render as it may be that a lot can be stabilised and kept, reducing the amount of new work needed, this has advantages from a conservation point of view also as more valuable original material will remain.



Testing Existing Plaster and Render

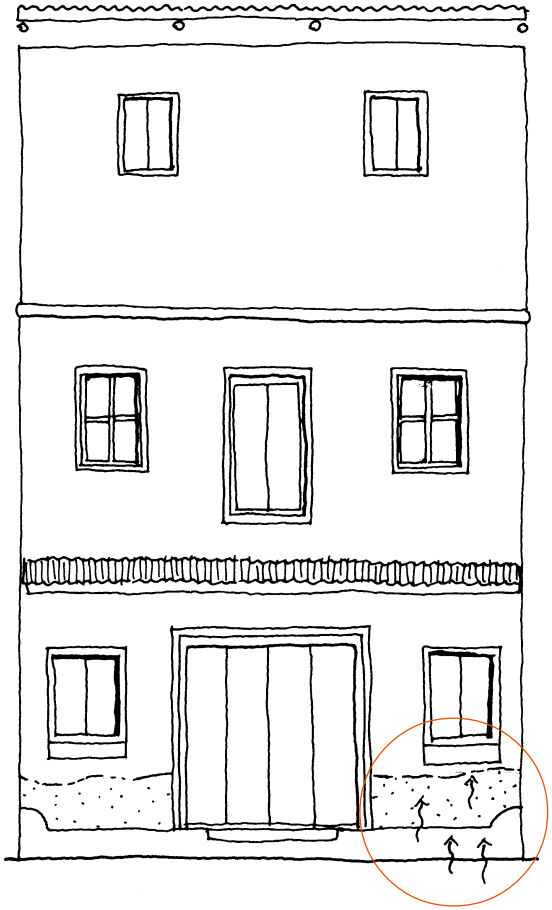
Testing is a very simple matter. The surface is lightly tapped with a small section of iron rod. If the sound produced is hollow the bonding between coats is poor. If there are only isolated areas that sound like this, the render is in good condition and can be kept. If, on the other hand it sounds hollow all over, it would be best to replace it.



If the wall surface is very badly eaten away, it will need more than just re-rendering; some attempt must be made to DESALINATE it as it will be contaminated with salt.

SALTS & DESALINATION

RISING DAMP



Rising damp patch

When looking for the cause of plaster failure on the ground floor, the first thing to look for is RISING DAMP. This simply means are the bottoms of walls and ground floors wet or damp? If they are it is necessary to find out WHY. If your house is in the Stone Town, unless it is very close to the sea, it is unlikely that rising ground-water will be the cause of the problem. Ground-water is water that is naturally contained in the earth and in the Stone Town will result from rain fall. If you live close to the sea, wall there is a chance that sea water that has permeated through holes in it whilst the tide was high is soaking through the soil and up into your house.

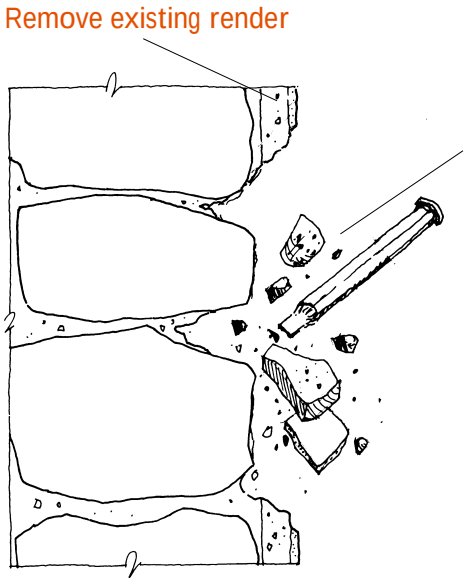
The depth at which ground-water is found below the surface is determined by the type of soil and strata. If the soil is not very porous, like clay, ground-water can be close to the surface and cause walls to be damp. The Stone Town is built on sand which is very porous so ground-water should not be a problem. However, walls can seem to suffer from serious rising moisture problems caused not by ground-water but by LOCALISED PONDING of rain water. This is caused by water draining through broken street covers and collecting against walls, saturating the wall below the street. Before re-rendering, this type of problem must be cured by carefully filling holes in the street covers and, if possible, making gentle gradients AWAY from the building and into the street.

Desalination is the name given to the removal of salts from stone, bricks, and renders, etc.

DESALINATION

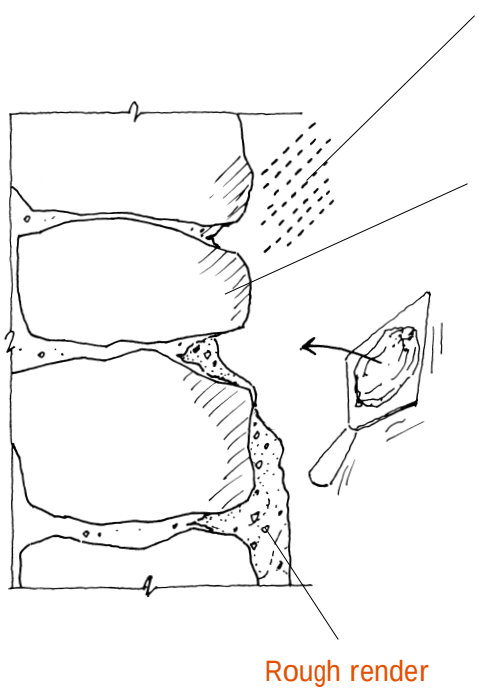
A great deal of the salt contaminating buildings in the Stone Town comes from the use of beach-sand and other aggregates with high salt contents. It is also possible that sea water was used in construction and for slaking lime. Masonry walls are therefore often contaminated to their full height and thickness, a situation making complete desalination impossible.

However, if salt content is reduced or eliminated in the outer 150mm of the wall surface before new render is applied, it is likely that the new render will survive. This is because if the salt is removed from deeper than from where the rain penetrates, the salts within the wall will not turn into a solution and migrate, damaging the surface.



The only sure way to remove salt is to remove as much as possible of the material that contains it.

1. The first step is to cut away all the damaged render right back to the large corals forming the walls. If the mortar between the corals is not firm and solid, this should also be removed.

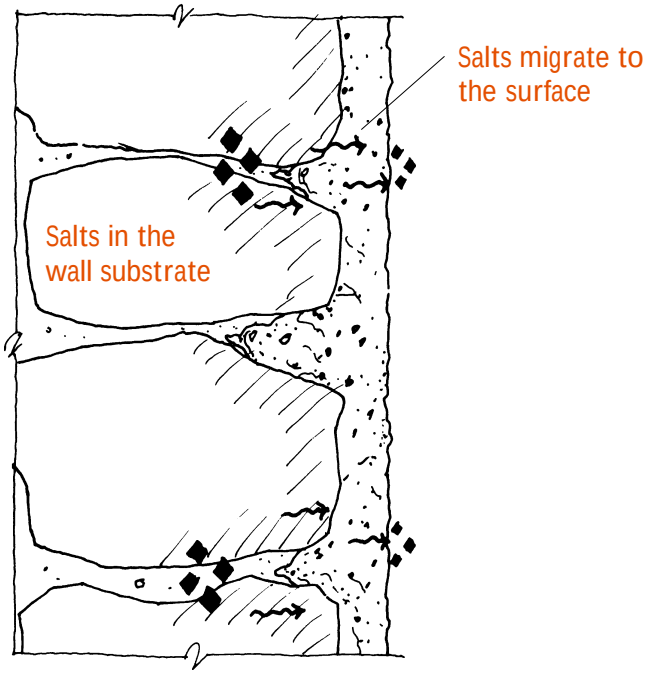


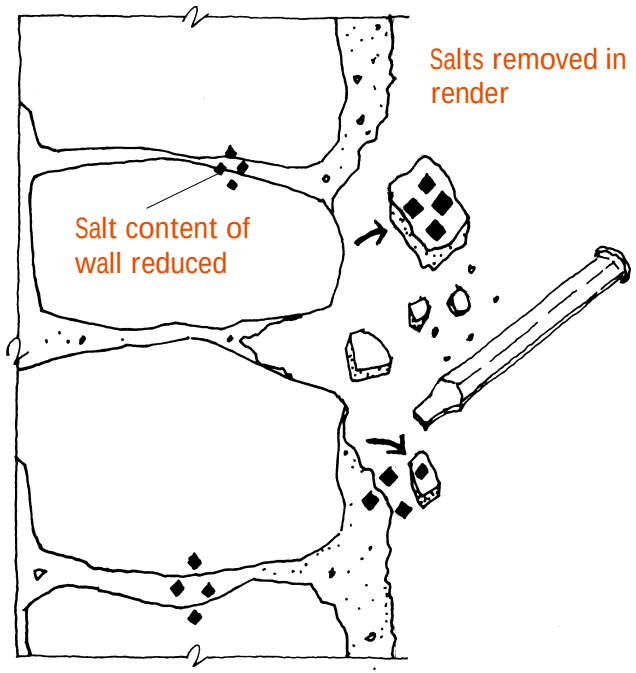
2. The surface of the wall is next saturated with clean drinking water and apply a ROUGH RENDER whilst the wall is still wet. A rough render consists of a coarsely broken porous aggregate mixed with a lime binder. The traditional mix of 1:3 is normally used. It is not necessary to use expensive good quality lime, ordinary HYDRATED LIME from the building merchants will do. The aggregate can be any broken up coral with a good range of particle sizes. The mix is quite wet and should be THROWN against the wall to ensure contact.

3. It is the job of the rough render to draw salts out of the masonry. The water applied to the wall will soak into it and on its way, dissolve much of the salt in its path. Eventually, it will begin to return to the surface for evaporation. As it does so, it will carry its charge of salts along with it. The rough render will act as an extension to the wall and the water and salt will move on through it to the surface. There, the salts will be concentrated.

4. When quite dry, the salt infested render is removed and cleared away from the site. It is important that the rough render does not get wet after it has dried and before it is removed. If rainfall is allowed to saturate it, there is a danger that salts contained in it will be washed back into the wall.

5. When the process is completed the salt content within the masonry should be much reduced. If rising moisture is not present the treatment should be a permanent cure, assuming the rerendering is well done and when complete is maintained! However, if the house is close to the sea wall or still suffers from rising damp due to ponding, the new render may be damaged again quite quickly.



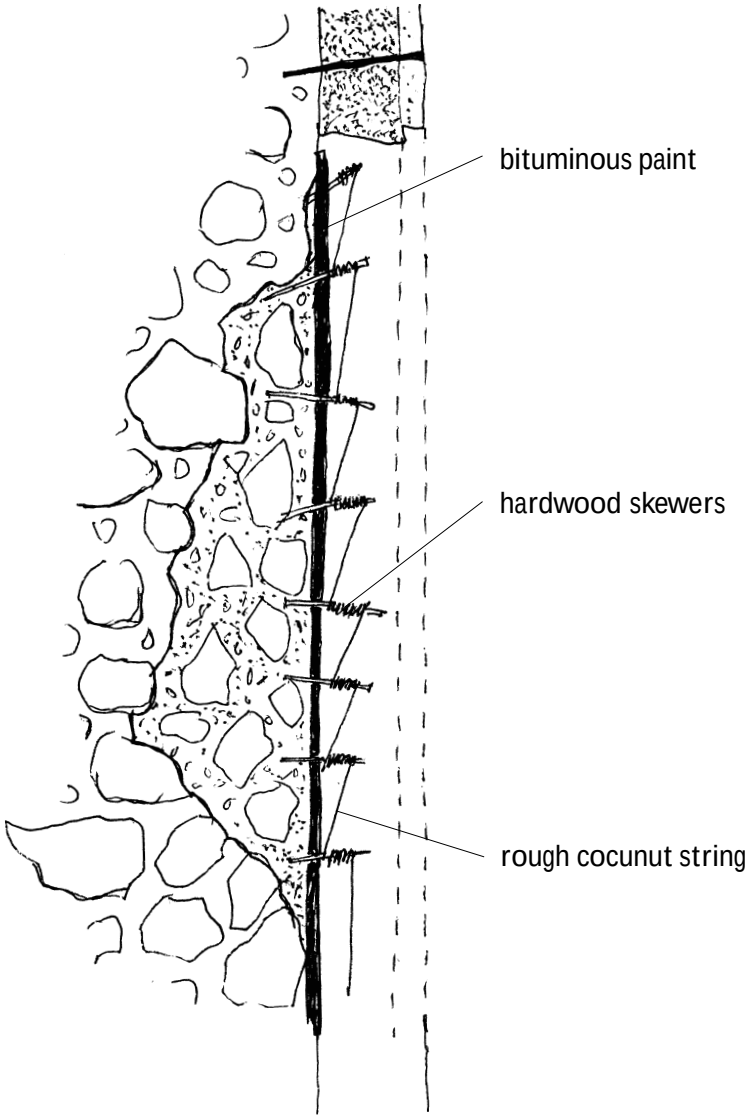


ISOLATING SALTS WITHIN MASONRY

If after desalination the wall is still obviously contaminated, it will be necessary to isolate the salts from the new work. This simply means that a WATER-PROOF BARRIER has to be set up between the wall and the new render.

The work should begin by vigorously brushing the wall with wire brushes to remove more of the contaminated surface material without digging too deep into the mortar between corals. The wall is then brushed with soft brushes to remove dust. The edges of adjoining intact render should be pointed and secured. In order to make the isolating barrier between wall and render, the entire affected area is painted with a layer of bituminous paint. Once dry, re-rendering may proceed.

For the new render to adhere to the paint, a number of short hardwood skewers approx.100 mm long should be prepared and hammered through the bitumen and into convenient mortar joints beneath at about 300 mm centred vertically and horizontally. Rough coconut string is tied around and between each of the skewers to make a strong net effect. The net will hold the render firmly against the wall.



RENDERING

WALL PREPARATION

The wall is first thoroughly wetted with clean water, this helps the new render to stick. If the wall is not wetted, the dry stones and mortar quickly SUCK much of the moisture out of the render and it will not bond with the wall. In all plaster work, it is important to remember that the various coats are not GLUED together. ALL that causes them to stick is friction and, for this to work, the new render must contact every part of the face of the wall or render. If the wall is not wetted and the render dries very quickly, it does not have time to take hold of the rough surface and the bond will be weak.

MIX RATIOS

	SOIL	SAND	DUST 1*	DUST 2**	LIME
Filling deep holes & dubbing out	3	0	0	0	1
Render coat	0	0	3	0	1
Setting coat	0	0	0	1	1

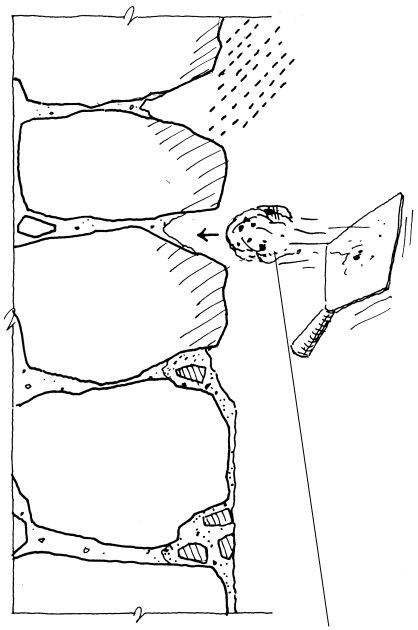
* **Dust 1** is crusher dust
** **Dust 2** is finely crushed soft white coralstone.

DUBBING OUT

This is the name given to filling the deeper holes and scars. Dubbing out brings the wall surface to a rough average flatness. Following wetting, a 1:3 mix of lime and red laterite soil is THROWN off the end of a trowel into the hole. It should be about 40mm thick.

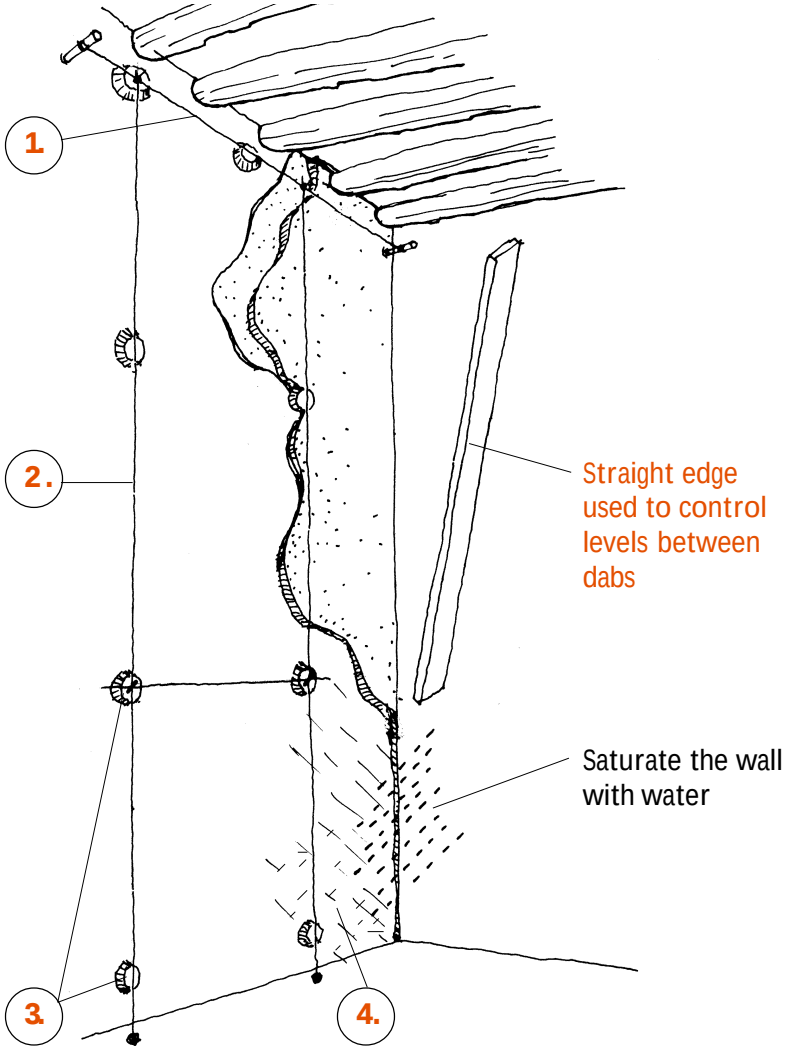
Small stones are then pressed into it. The stones are first immersed in water to saturate them. Using stones in this way will reduce shrinkage and the water contained in them will help control drying and reduce cracking. If the work is in direct sunlight, it must be protected by hanging sections of wet Asian cloth in front of it. Direct sunlight will cause it to dry too quickly and crack.

If the holes are very deep, dubbing out should take place in two or three coats. Each must be allowed to dry, and all cracking and shrinkage must have ceased before the next is applied.



1:3 mix of lime and red laterite soil, 40mm thick

RENDER COAT



This is the name given to the first coat (closest to the wall). It is very important that the way it is applied reflects the character of the room. REMEMBER, WE ARE NOT BUILDING NEW HOUSES, WE ARE CONSERVING OLD ONES. THIS MEANS THE WORK CARRIED OUT MUST NOT BE BETTER OR WORSE THAN THE ORIGINAL. IT HAS TO BE THE SAME. So the rendering must be carried out with the old work in mind.

Remember that although the render coat is not the top coat, it DICTATES the look of the finished work. The top coat is only 3 to 5mm thick so it simply follows the line of the render beneath. If the render coat is not correct the top coat will also be incorrect. This is especially true of mouldings and arches.

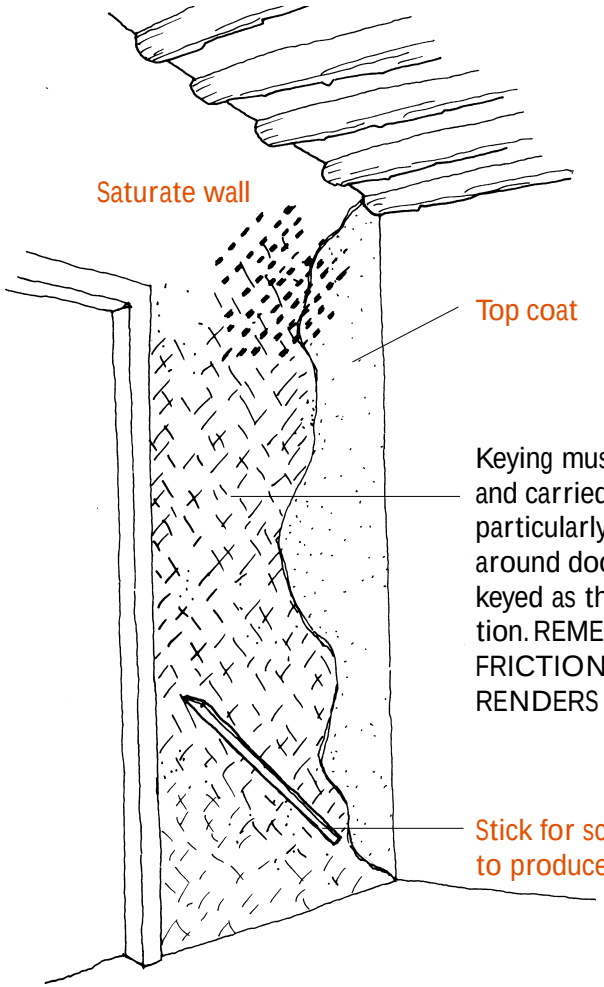
1. The wall and dubbing out are saturated. A line is stretched along the top of one of the walls a little below the boritis. It is stretched between hardwood pins driven into mortar joints. The line is about 40mm above the wall surface and represents the thickness of the plaster.

2. Pieces of line are then cut to about the same length as the height of the room. A bent nail or small stone is tied to one end of each line. The lines are now suspended at about 1.5m centrd from the horizontal line already set up. The lines act as plumb lines and control the verticality of the work.

3. Small dabs of plaster with a stone pressed into each are formed beneath the vertical lines at about 1,5m or 2m centres. When the dabs are set, the lines are removed, the wall saturated and plaster applied between dabs. A straight edge is used to control the level between dabs.

4. It is very important that the surface of the render is well keyed before it sets. To do this the surface has to be scored. Steel trowels must not be used for this purpose as the scoring is too thin, it is better to use a stick about 5mm or 10mm wide.

TOP COAT OR SETTING COAT

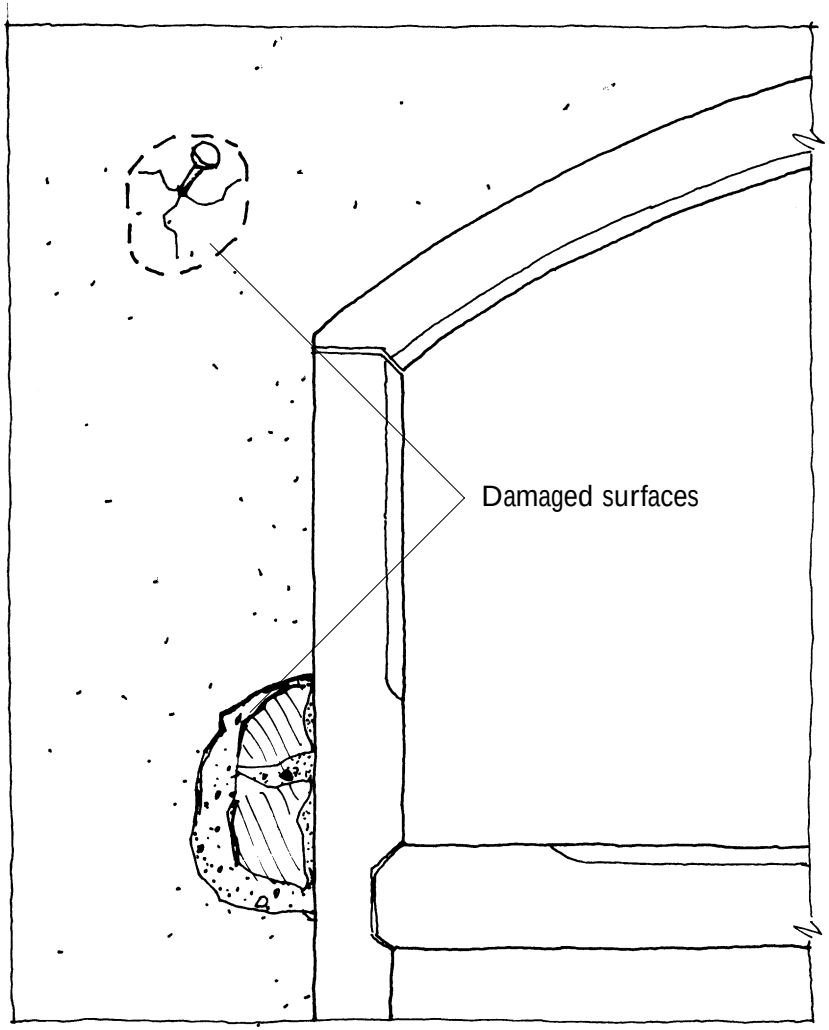


When the render coat is fully dried and all shrinkage and cracking has ceased, the wall can be dampened and setting coat applied. It is essential that the mortar is applied quickly, whilst still plastic.

It is best to apply setting coat with a flat wooden or plastic float. Plaster is placed on the float and very quickly smeared with an upwards action onto the wall. A small rounded steel trowel is used to 'iron' it firmly down onto the render coat. During this process the plaster is wetted as necessary so an average flat but undulating surface results.

Note: Examination of patination and texture on much of Zanzibar's historic render indicates that setting coat was originally applied with small rounded steel trowels. In order to maintain this texture similar tools or should be used.

PATCH REPAIRS



This type of repair is used for small areas of damage within larger areas of intact render. As the surrounding render is not damaged, salt is not likely to be the cause of localised damage of this kind. Patches are often required to improve the quality of surface, following the removal of cement mortar that may have been used to fill in following the introduction of an electric wire. or to make good places damaged by rusting iron fittings, etc.

REMOVAL OF RUSTING IRON, ETC.

The size and extent of the metalwork will dictate the precise details of removal but regardless of size, the principles will remain the same.

As far as possible, the fitting should be drilled out using a non-percussion drill so as to avoid vibration damage to the delicate bond between coats of render and masonry substrate. Holes are drilled at close centres around the outside of the metal, it is then gently tapped with a light hammer and gradually worked free. Should the feature be set deeply, it may be necessary to continue excavating the holes begun with the drill by hand. For this purpose a special chisel called a QUIRK is useful. The special 'fish tail' shape of the tool will permit very deep excavations with no damage to surrounding work. Once the metalwork is removed, the cavity in the wall is filled with mortar and small stones to the wall surface. When all shrinkage has ceased, the patch repair may proceed.

PATCH REPAIRS

Before placing a patch of new render the site must be prepared.
It is important that the joint between new work and old is crisp and regular, the joint should not be jagged and crude. A very sharp scalpel or craft knife is used to clean up ripped and broken edges around the site. The patch follows the line of the break but, avoid sharp and jagged angles. The edge is slightly undercut so as to help make a good key between old and new work.

Flush the site

The site is flushed free of all debris and dust. Flushing continues until the site is saturated and will accept no more water. Particular attention must be paid to wetting the various joints between layers of render and the masonry. It is important to pay attention to these joints, as capillary attraction along them is very strong and will rapidly suck water from the new render, leading to fine cracks parallel to the joint and a very poor bond.

Applying new render

During application, it is important that the work is compacted and that slightly more plaster is applied, ensuring that the patch does not become lower than surrounding work. When applying small patches within areas of vigorously textured original work, it is important that the repair should replicate the rhythm of the existing. If required, craftsmen should practice the required surface before final application.

Note: To ensure good bonding between new work and old, the repair site must be painted with a slurry of lime paste and boiled seaweed water. This mixture works as a binder and will secure the new work. If seaweed is not available, a dilute mixture of PVA and water can be used.

To prepare the slurry:

1. Take a small amount PVA wood-working adhesive and dissolve it at the ratio of 1:20 in clean warm water.

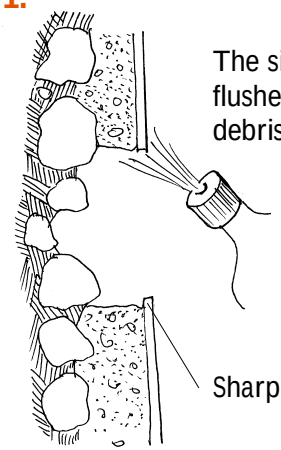
2. Take a small amount of setting coat and add 1/10 of a part of the PVA water, mixing the lime into a thin paste.

3. Take the slurry and using a small firm brush, vigorously work it well into the wetted substrate, ensuring as far as possible that some has been drawn up along the joint lines.

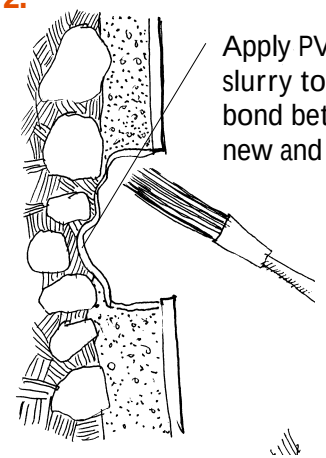
4. The new base coat should be applied immediately onto the slurry, ensuring that it is very firmly ironed down and compacted with some pressure against both substrate and all joint surfaces.

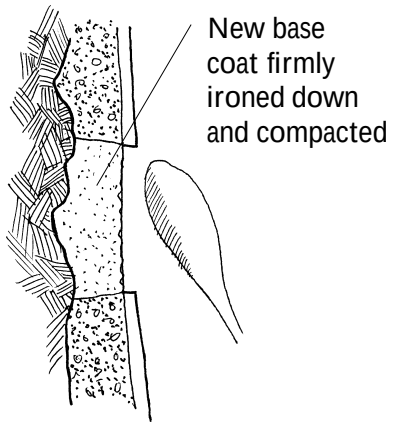
5. When fully dry and all cracking and shrinkage has ceased, the setting coat may be applied. Before applying the setting coat the entire site must once again be saturated and treated with slurry as described below.

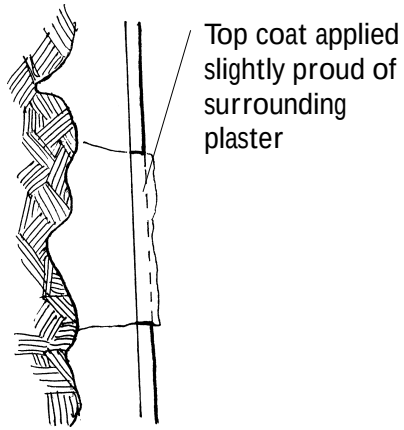
1.



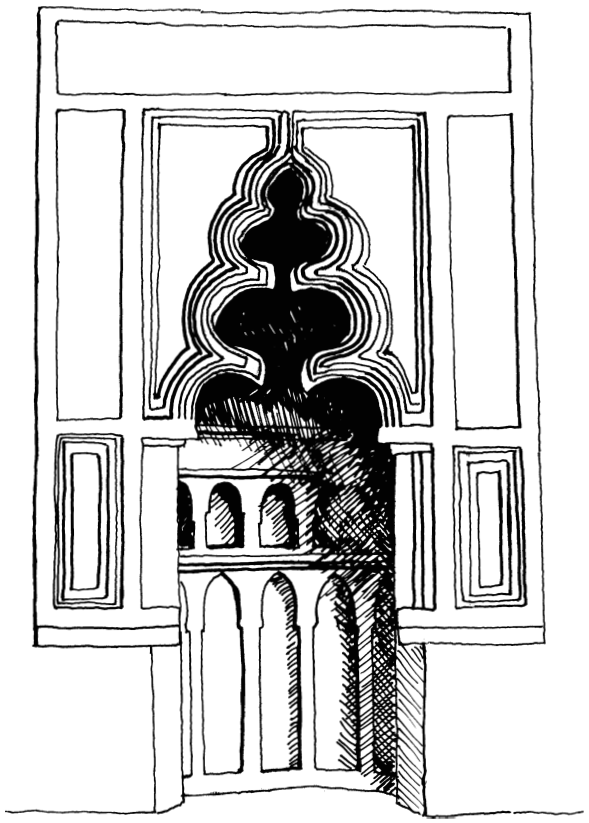
2.







REPAIRS TO MIHRABS



A slight variation on the patching procedure is required to repair the pointed cusps to mirhabs. These features are damaged very easily and are frequently broken off. Because they are pointed, it is not possible to mend them in the same way as holes in flat plaster.

To make the repair, and assist the plaster to stick, it is necessary to make an ARMATURE. This is simply a frame to hold plaster in place.

1. The first step is to remove all the damaged plaster and dust. A wheel brace and 5mm tungsten tipped bit are used to drill a number of holes in the widest parts of the repair site. The holes are flushed free of dust and the site saturated.

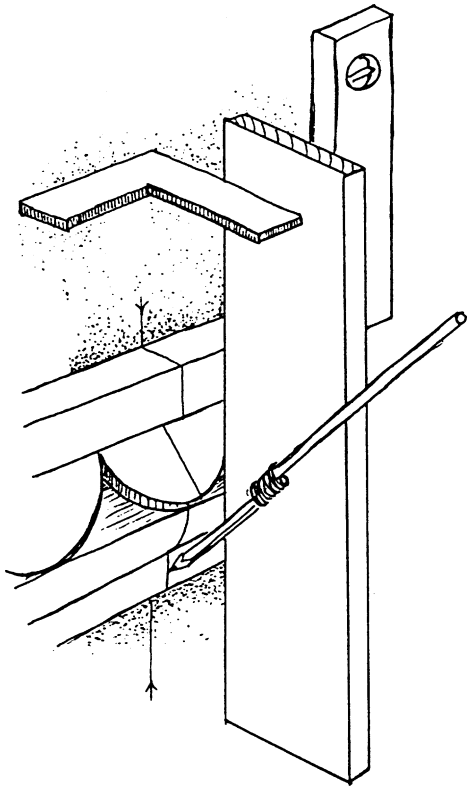
2. Small hardwood pegs are cut and set into the holes with sieved lime mortar (1:3) with the addition of a little PVA water or boiled seaweed water. Rough local coconut string is bound around and between the pegs forming a framework. The length of peg and general form of the frame is dictated by the nature of the individual repair and judgement will be required to make sure the frame is buried below the plaster. At no point should the frame come closer than 15mm to the surface.

3. The framework and site are again wetted and the lime slurry worked well into the surface. This is followed immediately by render coat which is firmly ironed down against the surface and around the peg and string framework. Once set the render coat is rubbed down with sand paper so that it more accurately follows the shape of the cusp. When all shrinkage has stopped the render coat is again wetted and setting coat applied in the normal way.

REPAIRING MOULDINGS

The method described above can also be used to repair mouldings. If the damage is severe and the mouldings are heavy, wooden pegs can be replaced with sections of ceramic tile.

To strike a vertical line across a moulding



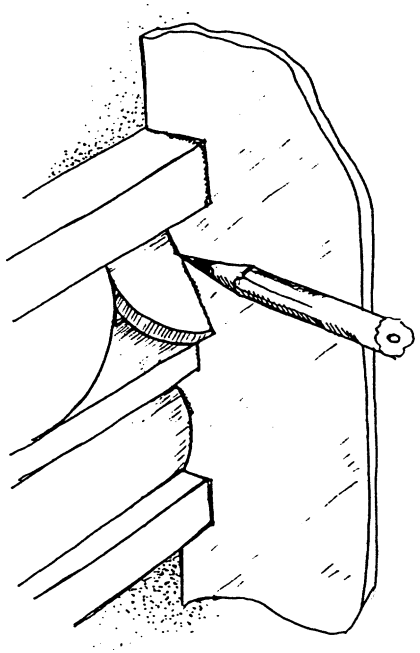
1. Place a flat board against the moulding.

2. Ensure the flat face of the board is at 90° to the wall by holding a square between both.

3. Ensure the board intersects the moulding at 90° by placing a spirit level against it.

4. To strike the line, tie a pencil to a piece of dowel and holding it tight aginst the board, strike the line.

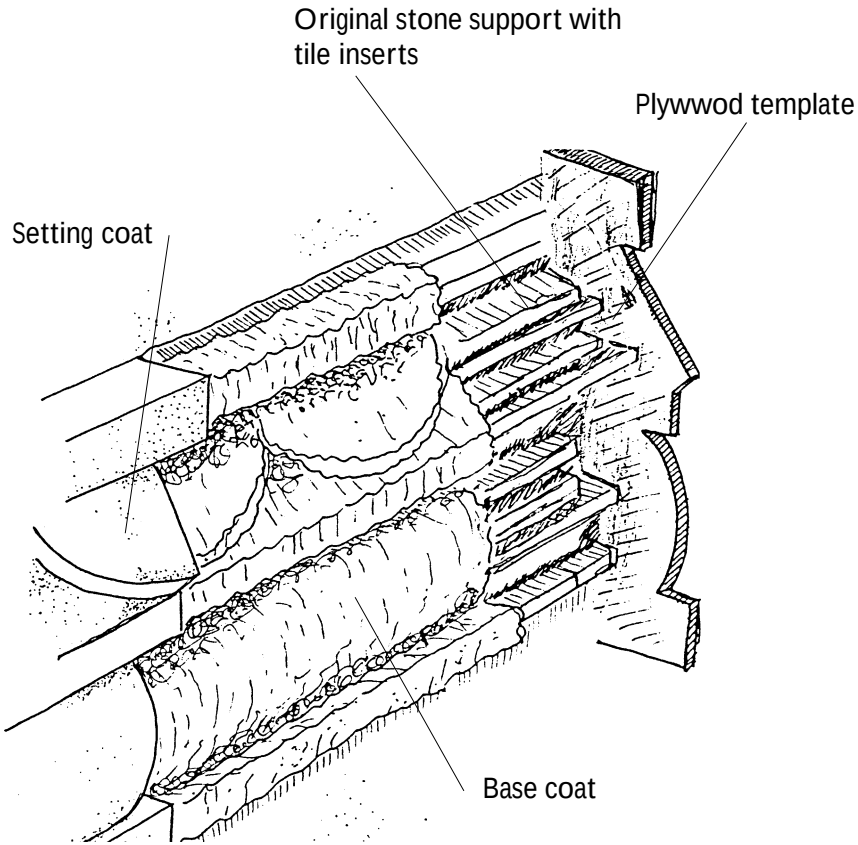
To record the section



1. Cut carefully along the line with a sharp hack-saw blade.

2. Insert card into the slot and draw the section.

To construct sections of mouldings



1. Place full-size plywood sections at regular intervals along the length of the repair.

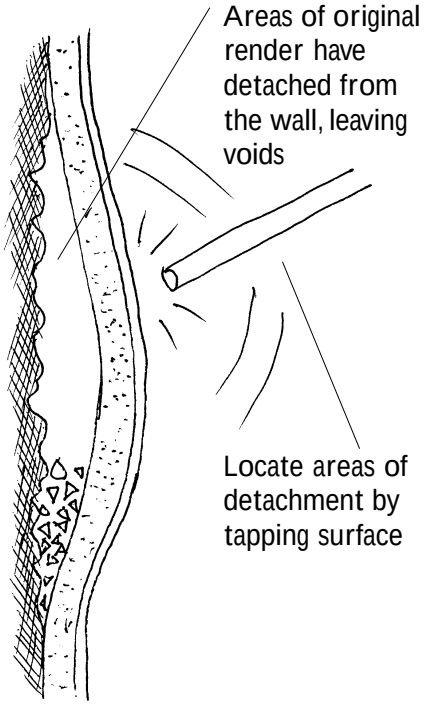
2. Reform the stones backing the moulding. Those that remain well embedded in the wall should be left. Loose stones must be removed and repalced with tile. Missing stones should also be replaced with tile inserts.

3. Acurate placing of the base coat is essential, the setting coat simply follows its line.

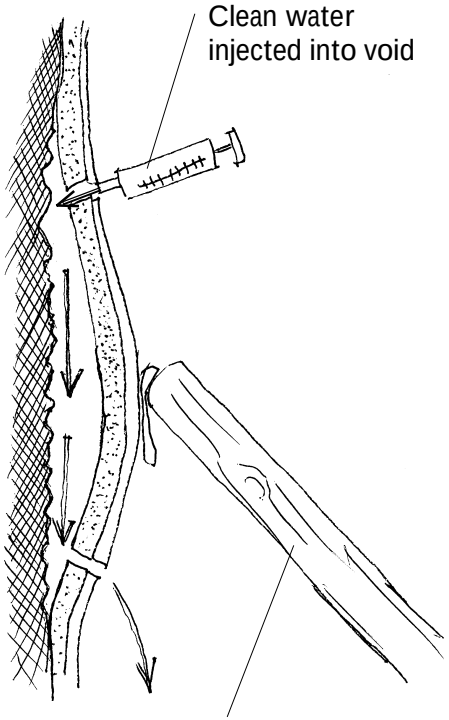
GROUTING AND PINNING

GROUTING

Steps 1 & 2



Step 3



To counteract the weight of grout causing the detachment to bulge, a piece of wood may be leant against the wall

Areas of original render that have lost adhesion and are in danger of falling from the wall, may be reattached by injecting a liquid grout into the space between render and wall. If the area of detachment is large, pinning may also be needed to secure the plaster. Grouting is an expensive and labour-intensive procedure and should be reserved for the conservation of valuable and interesting examples of plaster. In the Stone Town grouting is of value in the conservation of column heads, mirhabs, mouldings and stucco ornament.

WORKS SHOULD PROCEED AS FOLLOWS

1. The first requirement is to locate the full extent of the areas of detachment, some of which will be obvious while others will not. To find them, simply tap the surface with the blunt end of a pencil. Detached areas will sound hollow. As these are located, a soft pencil is used to mark their outline on the wall.

2. A number of 2mm holes are drilled at the lowest point along the bottom of each area of detachment so as to form a continuous slot about 10 to 15mm long. A single 3mm hole is drilled at the highest point in each detachment.

3. Using a large veterinary hypodermic syringe (with a blunt needle) inject clean water into the top hole in the detachment. As it enters, the water will flush out debris and plaster fragments from within the void and dampen the interior.

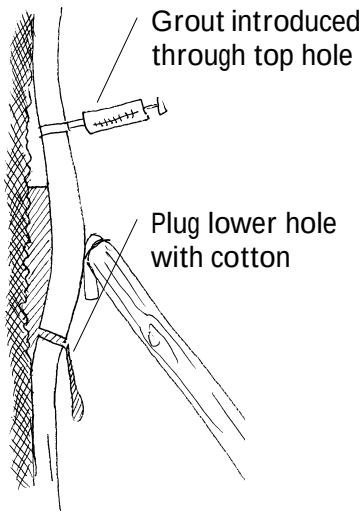
When fully wetted, a mixture of PVA wood-working adhesive and water must be rinsed through the detachment, causing the inside to become very slightly sticky and helps in re-attaching the render. The flush should be prepared in the following manner. A small amount of PVA adhesive must be dissolved in clean warm water in the ratio of 1:20.

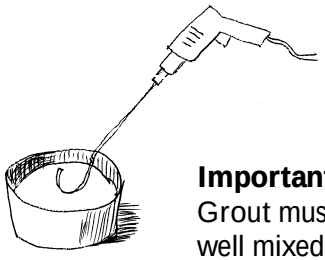
4. As soon as flushing is complete, the lower slit in the detachment is plugged with cotton wool and grout introduced through the top hole. To counteract the weight of grout causing the detachment to bulge, a piece of wood may be leant against the wall.

Grout should consist of the following:

Lime	2 parts
Very fine brick dust	8 parts
PVA water	as required

It is very important that grout is well mixed. Mixing should continue for at least 20 minutes prior to pouring. Thorough mixing can only be achieved with the use of an electric drill fitted with a bent wire mixing device. When grouting is complete the cotton wool plugs should be removed and replaced with a little setting coat.





Important
Grout must be well mixed using electric drill

PINNING

If the areas of detachment are large, it may be necessary to pin through the plaster layers and into the masonry beneath, in addition to grouting. Pins will help support the weight of the plaster and make the hole more stable.

Before pinning, it is best to allow one week after grouting. 3mm holes are drilled with a non-percussion drill in the middle of the larger areas of detachment. The pins themselves do not require great strength and it is more important that they are COMPATIBLE with stone and plaster. In Zanzibar, a very suitable material from which to make pins is well dried bone. Before inserting the pin into the hole, it is filled with a mixture of setting coat and a little PVA water. The pin is then pressed home and the hole sealed with more setting coat.

