

Heritage Building Conservation Technical Advice Sheet 3

Looking after limestone walls



Historic photograph - Cantonment Street, Fremantle c1900.

Fremantle is limestone

One of the defining characteristics of Fremantle is limestone-walled buildings. That so many of our older buildings are constructed of limestone is because the stone was quarried right here beneath the city. At first, irregular surface stones (capstones) were excavated from shallow depths on many building sites, and then as the city grew, small quarries were established to work the more uniform stone at locations that included Arthur Head, Cantonment Hill, Monument Hill, Fremantle Prison and the corner of Quarry and Parry Streets.

The mortar for bonding the stones was made from smaller pieces of the same limestone that were burnt in wood-fired kilns to produce quicklime. The lumps of quicklime were then mixed with local sands and slaked in a heap to make mortar. Look closely at old mortars and renders and you can see pieces of charcoal from the wood-fired kilns, and small lumps of white lime dotted through the mix.

The pattern of limestone walls

The extent of shaping (or dressing) of the stone depended partly on its nature and partly on its intended use. Some of the tough capstone was roughly-shaped and used in irregular pieces called rubble, while some was carefully dressed to fine tolerances for use as copings, quoins and other important building elements. The deeper stone was more easily worked and dressed to regular shapes, known as squared rubble. It was common for buildings to have more finely worked front walls of squared rubble, while the side and rear walls were constructed of smaller stones in a pattern described as random rubble.

Mortar joints of the finer squared rubble were often ruled with an incised line (and commonly painted) or finished with a raised ribbon pointing. Random rubble walls needed lots of mortar to fill the irregular spaces between stones with the result that their flush finishes often left only a small part of the stones showing through the mortar.



Ashlar blockwork with ribbon pointing; the raised ribbon is similar to tuck pointing of brickwork.



Squared random rubble with ruled joints; the incised lines were often painted (which was known as 'pencilling').



Flush-finished random rubble; mortar often covers most of the stones.

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Solid walls?

This photograph illustrates what solid walls can look like in cross section; they consist of a leaf of stones forming either side of the wall, with occasional larger 'through stones' to bond the two leaves together. While the outer (visible) leaf might be made of well-squared stones, the inner leaf (which was commonly plastered) was often made of smaller rubble. The centre (core) of the wall was loosely filled with small pieces of rubble and mortar.

As is obvious from the photograph, there are large voids in this apparently solid wall. Furthermore, the individual stones (and the mortar) are themselves quite porous; 20–30% of their volume can be tiny pores, between and within the particles that make up the stones and mortar. Both the larger voids and the smaller pores determine how these walls behave and how we should look after them.

Walls breathe!

Porous masonry walls, such as those of Fremantle limestone (and old bricks), exchange air with the atmosphere with changes in temperature and air pressure. As a wall warms up during the day, the air within it expands and so a portion of it moves out of the wall. Then, at the end of the day when the wall cools down, the air within it shrinks and so some air (including water vapour) is drawn into the wall. This process, which happens every day, is known as 'breathing', and the more porous the wall, the bigger the 'breaths' it takes.

When old walls were built it was accepted that a certain amount of dampness would penetrate into the pores and voids of the masonry and that this moisture would then evaporate naturally, mostly from the external face of the walls. Traditional mortars, plasters, renders and decorative finishes such as limewash were permeable to water vapour and this allowed the walls to breathe and to dry rapidly after rain.

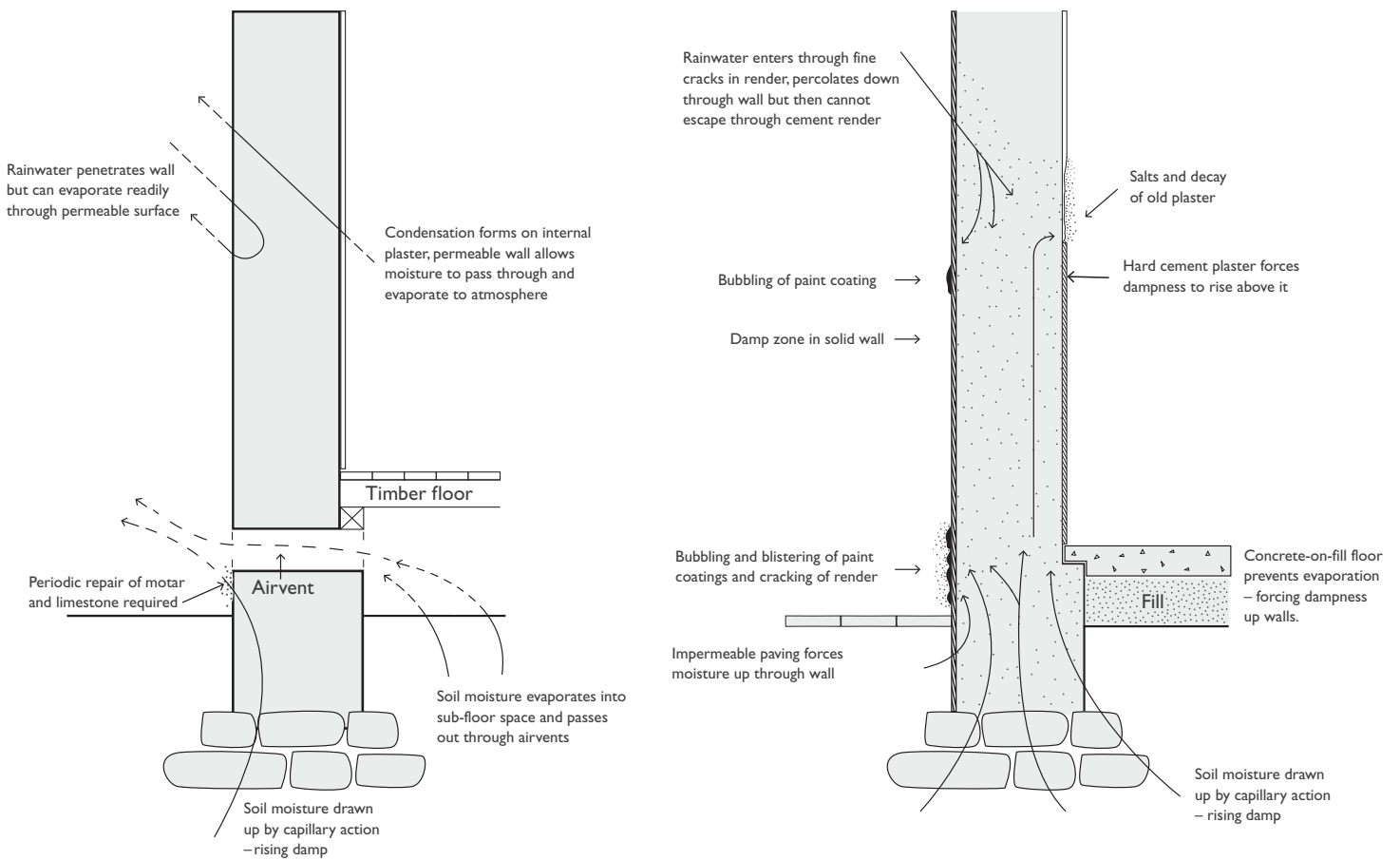
Periodic maintenance was required to replace deteriorated mortar, render and limewash, especially at the base of walls where rising damp and rain splash from pavements made the stonework wetter than elsewhere. Salts are often associated with rising damp and are a key factor in the decay of masonry materials (see Technical Advice Sheet 5 *Dealing with dampness in old walls*). Managing salts in walls requires mortars and renders with large pores to store the salt and to allow it to migrate to the surface where it will be removed, either by rain washing down the wall surface, or as part of periodic maintenance.



Sawn section through a solid wall of a similar limestone to Fremantle's. Note the large voids in the core of the wall. Occasional 'through stones' bond the outer and inner leaves together.

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On the left, a traditionally constructed solid wall is working the way it should, allowing moisture to enter but then escape by evaporation to the atmosphere. On the right is the same wall except that it has been 'repaired' with modern impervious materials, like hard cement renders and plasters, and acrylic paints. These prevent the wall from drying and so moisture that finds its way in is trapped in the wall and builds up, causing decay.

Don't fence me in

The diagram on the left of the previous page shows that, as well as exchanging air with the atmosphere, porous masonry walls absorb liquid water and give out water vapour. Looking after such walls means making sure that they can continue breathing. Repairs should make use of permeable lime mortars, plasters and renders. And like traditional limewashes, any coatings should be quite permeable. As these materials are not widely employed in contemporary construction, most of the professionals and tradespeople involved will not be experienced in their use, and are likely to turn instead to materials they are familiar with.

The diagram on the right of the previous page shows what happens when walls are repaired or 'updated' with contemporary materials such as Portland cement and acrylic paints. These relatively impermeable materials may reduce the amount of water entering the walls, but they will also prevent it getting out again, leading to water accumulating in the walls. Water will enter through small cracks in the render (or paint film) and then be dispersed through the porous wall, but most will not be able to evaporate out again because of the impermeable surfaces.

Signs of damage will be bubbling and blistering of paint films, and cracking and failure of renders. Because the failure points will initially be quite small, evaporation of the moisture will be focused on them, which in turn concentrates salts at these locations, increasing the damage. White powdery salts may be found behind sheets of failed render.

Internally, where hard cement plasters are used in attempts to prevent decay by 'locking in' the damp, the dampness will simply rise behind the new plaster and evaporate through the old plaster above (see Technical Advice Sheet 5 *Dealing with dampness in old walls*).

Be a good housekeeper

- Maintain roof drainage systems, ensuring that guttering and downpipes do not overflow onto walls, and that stormwater is carried well away from the base of walls.
- Keep garden beds, plants and watering systems away from walls.
- Check for and fix any plumbing leaks, including sewers.
- Maintain good sub-floor ventilation by cleaning vent grilles and removing obstructions.
- Lower ground levels if necessary so that there's about 200 mm clearance below damp-proof courses (DPCs) or below air vents if there are no DPCs.
- Ensure that the site is well-drained and that water does not pond (lie) against walls.

Let the walls breathe

- Remove non-original cement mortars and renders, acrylic paints and any other impermeable materials.
- Allow time for the walls to dry out thoroughly (i.e. most of summer).
- Remove surface salts with a vacuum cleaner (for deeper salts see Technical Advice Sheet 5 *Dealing with dampness in old walls*).
- Repair lime mortars with lime mortar (see Technical Advice Sheet 4 *Limestone walls need lime mortar*).
- Replace renders and plasters with permeable materials based on lime.
- Replace coatings with limewashes or similarly permeable materials, but don't use sealers or undercoats.
- Expect to do some more repairs in a year or so, as deeper salts come to the surface.

And don't

- Don't change the pattern of the masonry: repairs should match original work, repair original flush finishes with flush finishes.
- Don't sandblast or use high pressure water jets, for they will damage stone and mortar. Instead, remove paints with chemical strippers and wash down with low pressures.
- Don't replace ventilated timber floors with poured-on-fill concrete, as this will force dampness up the walls.
- Don't install damp-proof courses (DPCs) without understanding the potentially hollow nature of your solid walls, and that you need to deal with salts already in the walls.
- Don't use cement when repairing lime mortars, plasters and renders.
- Don't seal walls with water-repellent coatings, or use acrylic and more impermeable paints.

Further reading

Other technical advice sheets in this series

City of Fremantle Technical Advice Sheet 1
Introduction to good conservation practice

City of Fremantle Technical Advice Sheet 2
Checklist for inspections.

City of Fremantle Technical Advice Sheet 4
Limestone walls need lime mortars.

Coming in 2016

City of Fremantle Technical Advice Sheet 5
Dealing with dampness in old walls.

City of Fremantle Technical Advice Sheet 6
Repointing lime mortar joints.

These sheets can be downloaded from...

www.fremantle.wa.gov.au/cityservices/planning/conservationandcareofheritagebuilding



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