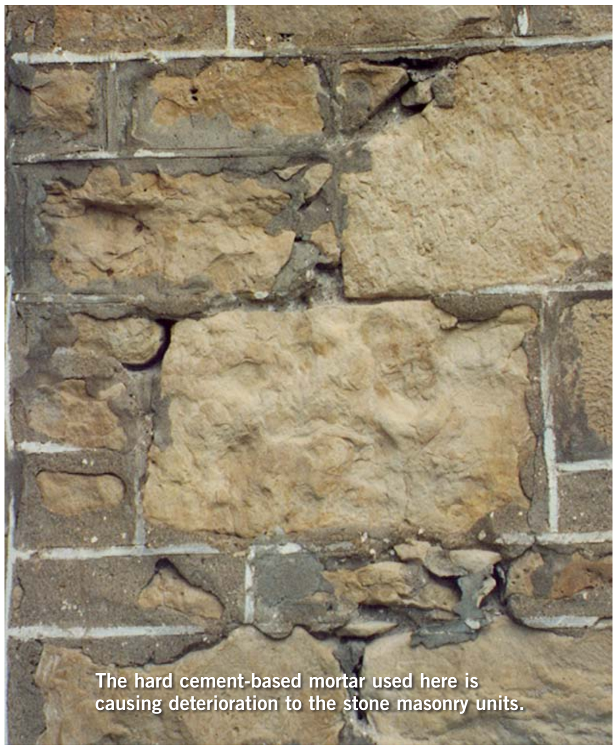
Traditional vs Modern Repointing MORTAR

When it comes to restoration, it pays to understand the difference

BY PAUL JEFFS


The hard cement-based mortar used here is causing deterioration to the stone masonry units.

A lack of understanding of the differences between traditional and modern masonry construction—together with a failure to address the cause of deterioration of older masonry—can often lead to the use of incorrect materials and practices for restoration. A typical example would be the use of hard cement mortars to repoint deteriorated mortar joints; a common misconception being that strong mortar is required to "glue" the masonry units together and form a rigid composite. However, as discussed later, the very strength of cement mortars can cause more harm than good.

The problem is compounded by the fact that it is generally more expensive to restore deteriorated masonry—when it is carried out correctly. However, the cost may be even greater (or damage continue to be caused, sometimes at a faster rate) should the restoration work not be carried out using the right materials and/or practices.

Traditional Lime Mortars

Before the availability of portland cement in Canada, masonry mortars for house building were based on mixing sand with hydrated lime, the latter being produced by burning crushed limestone rock in a kiln, grinding the fired material and blending it with a precisely controlled amount of water. Portland cement is produced by processing silica and alumina (predominantly sourced from quartz and clays/shale) with limestone. These additional materials enable portland cement to set and harden rapidly by chemically reacting with the mixing water, a process known as hydration.

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The advent of portland cement into North America toward the end of the nineteenth century resulted in it often being blended with lime so the benefits of fast setting and hardening of masonry mortars could be achieved. This practice has evolved so that today the most commonly used mortar consists of equal parts by volume of cement and hydrated lime, mixed with six parts of sand.

Without the addition of portland cement, freshly mixed hydrated lime mortar first undergoes a stiffening process, since a considerable amount of the mixing water is absorbed into the masonry materials, or it evaporates from the exposed "skin" portion; then the mortar gradually hardens over time by the lime reacting chemically with naturally occurring carbon dioxide gas, a process known as carbonation. The chart on page 26 schematically illustrates the reactions that take place during manufacture and during the use of hydrated lime.

Strength development with pure lime mortars occurs very slowly, beginning first with the exposed portion forming a "crust." The products of the carbonation reactions—predominately calcium carbonate—slowly block the pore structure of the mortar, and so the rate of the reactions continues to diminish as the gas diffuses through the thickness of the mortar. This is why old mortar can be scratched to find it is sometimes much softer behind the fully carbonated layer.

The time required for hydrated lime to fully carbonate within traditional mass walls can be measured in decades and will be dependent upon the availability of carbon dioxide and moisture, both essential for the reactions.

Because of the described reactions, hardened lime-based mortars probably never reach

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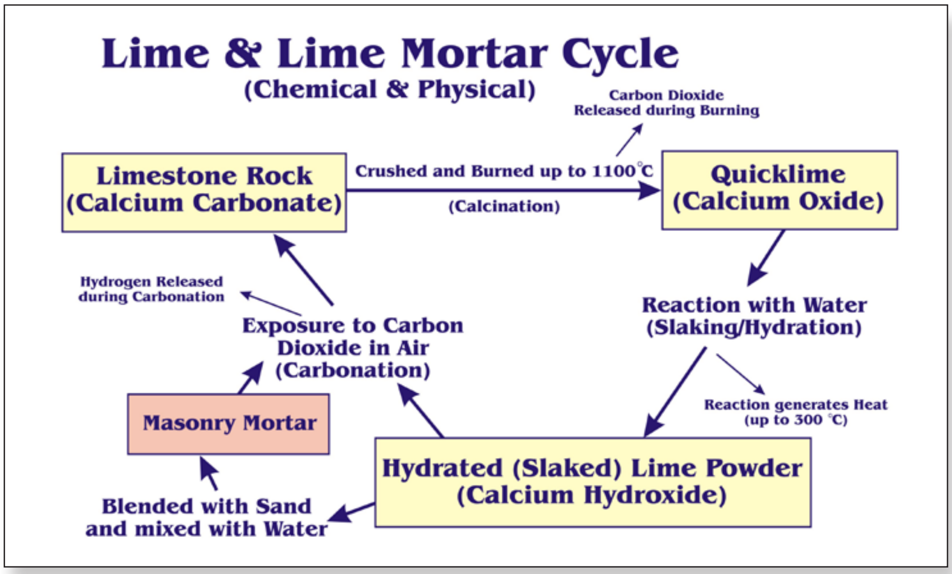

24 ▸ even the very early age strength of portland cement-based mortars throughout the thickness of the masonry. Although this may seem to be an undesirable property it is, in fact, the main reason why heritage masonry has generally performed very well for long periods—sometimes for 50 to 100 years—without the need for major restoration. The "soft" characteristics of the mortar provides mass masonry with the ability to withstand the effects of stresses that may occur from movement, including the initial "settling-in" of the assembly, wind and snow loading, and the subsequent expansion and contraction of the various components during their exposure to extremes of temperature.

The Importance of the Mortar

When repointing deteriorated joints within historic masonry, it can be a big mistake not to appreciate the importance of compatibility of the new mortar with the masonry units, whether the latter are brick or stone.

Modern masonry walls are typically constructed with vertical cavities, using weep holes to facilitate drainage of water that may penetrate the assembly. Traditional masonry walls were designed to have sufficient thickness that, should water penetrate, before it could reach the interior the moisture would transmit back to the exterior as a vapour and evaporate. However, adequate "breathability" (moisture vapour transmission capability) of the entire masonry—mortar as well as brick or stone—is essential for this to occur satisfactorily.

Traditional lime mortars were, and still are, very breathable and therefore tend to dry at a similar rate to brick or most natural stone. Conversely, modern cement-based mortars are dense and very slow to dry. Therefore, when water penetrates the masonry it may transmit to the exterior when the ambient conditions are conducive to drying, but the dense nature of hard cement mortar can prevent it from drying at the same rate as the remaining masonry. Should freezing take place before the cement mortar is able to adequately dry, then damage could be caused to the weaker components: the masonry units.

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A further problem with cement/lime mortars is that they generally have tenacious bond to the masonry units. This may not be a disadvantage should the units be tough enough to withstand the stresses that develop when subsequent drying shrinkage of the mortar takes place, but older masonry tends to be less resilient and the stresses may be sufficient to cause damage. Alternatively, separation gaps may occur at the bond interface and these can then easily facilitate the ingress of water.

Finally, when masonry is exposed to the extremes of our Canadian weather, hard cement-based mortars will generally expand and contract at quite different rates compared to some older brick and stone masonry units; stresses thereby developed at the interface between the mortar and masonry unit can then result in damage being caused to the weaker materials—once again, the masonry units.

It therefore follows that, for repointing older buildings, the mortar should be designed to be sacrificial to the more valuable brick or stone. This means that it should be equal to or somewhat weaker in strength than the remaining original mortar within the joints, it should have comparable breathability to the brick or stone, it should develop a reasonable level of adhesion at its interface with the masonry units, and it should exhibit low shrinkage characteristics while it sets and hardens.

Making the Selection

Perhaps the biggest enemy the owners of older buildings face is a lack of awareness of the dangers that await them should the wrong materials or practices be used to restore masonry, no matter how well-intentioned they may be in their selection. However, perhaps the greatest mistake is to make the selection based on the cheapest price—without having regard for what the true cost will be should that strategy not work effectively.

Most of the discussed problems can be avoided by selecting a specialist masonry contractor well versed in traditional repointing practices, who will use a prepackaged mortar based on natural hydraulic lime. (Hydraulic lime is produced by the manufacturer blending small proportions of silica and alumina to produce a weakly "cemented" hydrated lime.) This combination may not prove to be the most economical, but is should be the most effective—and the most long-lasting.

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