

# Modern Materials and Techniques for Historic Masonry Structures

By Paul Jeffs, PJ Materials Consultants Limited

## TRADITIONAL MASONRY

Effective strategies for the conservation of historic masonry should consider many aspects. Perhaps the most important of these is the selection of restoration materials and techniques that are sympathetic to the differences between traditional and modern-day masonry structures — both in terms of how they were designed to perform and how they age and deteriorate.

The methods and materials used to build masonry in the 19th and the early parts of the 20th century were very different from those used for modern buildings. Traditionally, until concrete block or reinforced concrete became economically available, at least the foundations were constructed using natural building stone to form thick, solid masonry walls. In addition to the largely conservative approach to structural considerations, the thickness was considered essential to provide effective insulation value and limit the potential for moisture ingress to the interior. This approach was considerably different to the modern use of cavity wall construction incorporating veneers, insulation, air and vapour retarders, cavity drainage systems, etc.

## MASONRY MORTAR

Traditional mortars were predominantly hydrated lime based; that is, unlike Portland cement, they did not set and harden by reactions with the mixing water — although techniques were sometimes used to create hydraulic reactions by blending clay or ground brick. Without the presence 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 hardens over time by the lime reacting chemically with atmospheric carbon dioxide — a process

known as carbonation. This major difference compared to modern masonry mortars provided the following inherent beneficial properties:

- Good “breathability” to contribute to rapid drying of the masonry.
- Low shrinkage to avoid stress at the bond between mortar and masonry unit.
- Good adhesion to maintain a tight joint.
- Compatible strength/modulus with the masonry units to avoid stress transfer.
- Ability to “self-heal” cracks.

Failure to appreciate the difference between modern and traditional masonry mortars has often led to restoration that has been inappropriate, sometimes resulting in failure and more rapid deterioration. For example:

- Hard cement-based mortars can create a more rigid assembly that cannot accommodate movement without the development of cracks.
- Cement mortars are slower to dry and, at critical times, can result in damage from freezing conditions (see Photograph 1).

However, there are some occasions when even lime-based mortars have never performed well and should not be used for repointing work — in fact, nor should modern-day cement-based mortars. Examples include “skyward-facing” joints that become saturated for extended

periods, entrance steps and stairways exposed to de-icing chemicals, and hard stone masonry units, such as granite, which are subject to excessive movement from temperature change, etc. Although most heritage conservation specialists are reluctant to use non-traditional materials — which of course were not available to our forefathers — the only modern-day materials that have proven to outperform masonry mortars in this regard have been elastomeric joint sealants such as silicone or urethanes.

## THE AGING PROCESS

It should be appreciated that all mortars — regardless of the type of binder — will eventually weather and deteriorate, typically providing a passage for water to infiltrate the masonry assembly and create further, hidden deterioration. Repointing deteriorated joints should therefore be considered a high-profile maintenance process — together with sealing joints with elastomeric sealants. It should also be appreciated that lime-based mortars do get harder with age and eventually the ability of the masonry to accommodate the effects of natural movement will diminish and cracks can occur — particularly since movement joints were rarely incorporated into the design of traditional masonry. Consideration should therefore be given to whether the cracks are providing the function

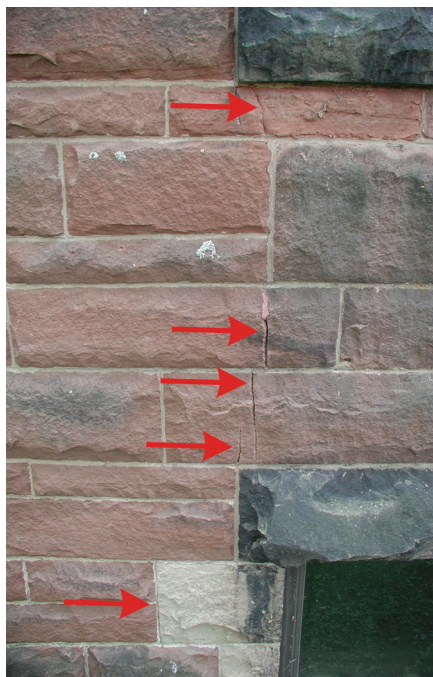


Photograph 1



of expansion and contraction joints, preventing the development of further stress. In this event, simply repairing the cracks can sometimes lead to failure of the repair — or more cracks occurring.

It is also important to consider whether cracks have been caused or influenced by other factors, such as poor design of lintels and sills to inadequately extend beyond window opening jambs (see Photograph 2), or destabilization of foundations. Water that infiltrates below-grade masonry can often leach out the lime component from the centre core and this can result in gravity loads being transferred to the exterior wythe. These and other influencing factors should be included in the restoration process, perhaps using some of the materials and techniques discussed next.



Photograph 2

### MODERN MATERIALS FOR TRADITIONAL MASONRY CONSERVATION

There are many products and systems available today that have been specially designed, formulated or adapted for use during the restoration of heritage structures and older buildings. Some of these include:

- Prepackaged repointing and bedding mortars based on hydrated or hydraulic lime and designed to be compatible with traditional masonry.

- Prepackaged non-cementitious repair mortars designed to have compatibility with a variety of masonry substrates.
- Stainless steel helical masonry ties that can be used to stabilize masonry and improve composite action across the assembly — they can also be used for crack-stitching repair techniques.
- Stainless steel helical rods that can be embedded in a high-strength grout within horizontal joints to improve the distribution of gravity loads away from window openings and/or cracked sections of masonry.
- Cellular foam grouts and low-pressure injection techniques that can be used to fill voids and cavities within the centre core of masonry walls and provide restored stabilization without changing the foundation's ability to adequately accommodate movement.
- Elastomeric joint sealants designed to have a similar appearance to masonry mortar, for use where movement accommodation or resistance to de-icing chemicals is not provided by a traditional material.

### CONCLUSIONS

The biggest enemy facing the owner of an old building is a lack of awareness of the dangers that await, should the wrong materials or practices be used to restore masonry — no matter how well-intentioned the selection process may be. Oftentimes, the selection is based on the cheapest price without having regard for what the true cost will be should the strategy not work effectively. When faced with cracked masonry, deteriorated mortar joints, etc., it is important to understand just how expensive it can be to “fix it right,” using the right materials and the right techniques. ■

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