



TECH TALK

This issue: Building Materials • Part II



Treatment and Maintenance of Masonry by Charles W. Nelson

In the previous “Tech Talk” (November 1997), the principal categories of masonry were introduced. These include stone, brick, concrete, terra cotta (or clay tile), and stucco. With the exception of poured concrete, masonry construction is comprised of individual units, held in place with mortar. (Historically, mortar is a mixture of lime, sand, and water; modern mortars are strengthened by the addition of Portland cement to the mix.) As with any building material, masonry is vulnerable to the effects of weathering. A proper program for periodic inspection and maintenance is critical to the preservation of masonry structures. Neglecting to have such a program could eventually mean the loss of the structure itself. This “Tech Talk” will address the identification of problems and selection of remedial treatments.

Water: Masonry’s Enemy

Water, or moisture generally, is directly or indirectly responsible for the majority of problems in masonry, and in virtually every type of construction. Water may enter a building from the ground or through walls and roofs. In the form of water vapor, it may be trapped within the structure and wreak havoc before the full consequences are discovered. Saturated masonry is especially prone to lose its structural properties, causing it to break down to the point at which the units essentially collapse. In Minnesota, this problem is greatly increased by wide fluctuations in temperature and humidity, which retard or temporarily halt the natural drying process that is so essential to preservation.

Editor’s note: TECH TALK is a bimonthly column for offering technical assistance on management, preservation, and conservation matters that affect historical societies and museums of all sizes and interests.

The most common point of entry for water is the mortar joint. Mortar bonds the units together; it must be strong enough to maintain this bond, but it also must be flexible enough to allow the structure to “breathe” in response to natural temperature fluctuation. Wind and rain cause erosion of the mortar, exposing sand aggregate. Continual erosion results in the receding of the mortar, resulting in open penetrations into the wall. When water enters these openings, it may saturate the interior and may freeze. When water freezes, it expands, driving the joint



SHPO, MHS; photograph by Charles Nelson

The author points out water-caused deterioration of these mortar joints, and the inappropriate use of Portland cement patching mortar.

open, forcing the masonry units apart, and eventually breaking the bond. For this reason, it is critical that mortar joints be inspected and maintained in sound condition. The accepted treatment is to replenish lost mortar by *repointing*.

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Repointing

When repointing masonry, it is important to remember a simple rule: *The mortar should be softer than the material it bonds and should match the original in composition and application.* The most common mistake is using a mortar that is too hard, a characteristic found in mortars high in Portland cement. Such mortars do not expand and contract in proportion to the units. Two situations arise: cracks form between the mortar and the unit, allowing water to enter the wall; or the unit itself fractures, and the mortar prevents the unit from expanding with heat. An unfortunate consequence is loss and inevitable replacement of the unit.

Selection of repointing mortar should be based on a familiarity with the structural properties of the masonry units in the wall. It should also take into account the color of the original mortar and the profile, or striking, of the joint. Another rule to remember is, *Mortar requires approximately 21 days to cure to final strength and appearance.* Pigments added to repointing mortars require time to cure if they are to match. For



SHPO, MHS; photograph by Charles Nelson

This photograph shows damage to mortar and masonry caused by a leaking gutter.

this reason, test areas should be required about a month prior to the actual repointing project. In Minnesota's climate, repointing should be done before October 15th to allow adequate curing time before a hard freeze (unless the area is heated).

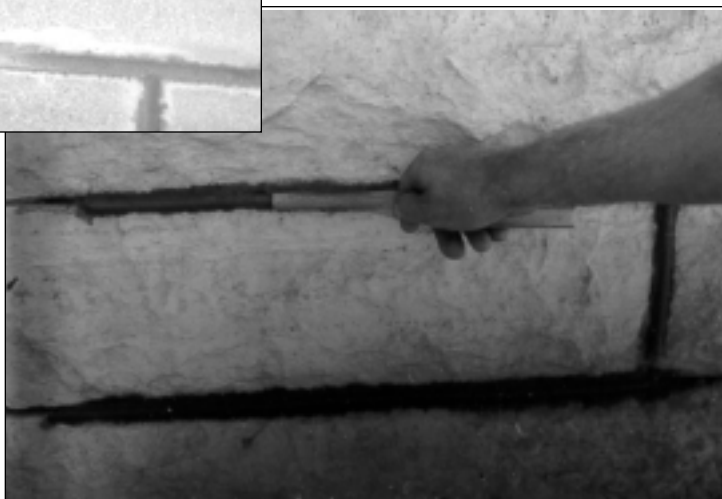
To reduce the potential of damage to historic masonry units, it is advisable to avoid use of pneumatic tools and saws; hand chisels are preferable. In cases where the wall is comprised of modular units, such as brick or block, saws may be used, but

only on horizontal joints. You have to be extremely careful not to widen the joint, however, for this damages the units irreparably and alters the appearance of the wall. To achieve the final profile, the joint can be struck to various depths and profiles; striking the joint gives it a final finish which aids in resisting weathering. Or, you can apply a "finger joint," which has a concave profile as if the final finish was the result of dragging a finger on the surface. (*Preservation Brief #2: Repointing Mortar Joints in Historic Buildings* will provide additional guidance on this issue.)



SHPO, MHS; photograph by Charles Nelson

Above: A sample of mortar is being matched with the historic mortar; just below it are profiles of "finger joints" made by striking the mortar with the finger.



SHPO, MHS; photograph by Charles Nelson

A special tool is used to strike the joint into a raised convex "bead."



Cleaning Masonry Surfaces

The Secretary of the Interior's Standards for the Treatment of Historic Properties specifically states: "Chemical or physical treatments, if appropriate, will be undertaken using the gentlest means possible.



SHPQ, MHS; photograph by Charles Nelson

A sandblasted wall, showing irreparable damage to the bricks; the outer surface has been abraded away, leaving the softer interior open to the weather.

Treatments that cause damage to historic materials will not be used." Carrying this standard a bit further, I would suggest an eleventh commandment: *Thou shalt not sandblast!* The abrasive impact of sandblasting effectively increases the material's vulnerability to erosion, and significantly shortens the life expectancy of the structure. With sedimentary stone like limestone, softer areas are easily abraded and destroyed. In the case of brick, the "crust" resulting from its kiln manufacturing process is removed or penetrated, allowing water to be absorbed into the soft interior. (For additional information, refer to *Preservation Brief #6: Dangers of Abrasive Cleaning to Historic Buildings.*)

A variety of chemical cleaning products has been developed and introduced on the market. These products include spray-on applications as well as poultices that draw out embedded dirt and pollutants. It is important that each product be tested on-site to assess its effectiveness. Many chemicals have adverse residual effects if not applied in strict accordance with manufacturer's specifications, so any such application must be undertaken by a professional contractor familiar with the product and its technical properties. It is not a job for amateurs.

Remember, too, that the best cleaning agent is the most gentle; it will remove only what may be detrimental to the material while retaining its natural patina of age. For example, a caustic chemical can remove the protective surface-glazing from terra cotta. Applications of acidic cleaners can cause lime mortars to effloresce, resulting in white staining of the surface and potential weakening of the strength of the mortar. Care must be taken when removing paint from masonry surfaces if such paint contains lead. Some dirt is easily removed by simply wetting the building surface with a biodegradable detergent, letting it soak in, and then rinsing it away with a garden hose. Stubborn residue may be dislodged with a stiff bristle brush. (For additional information, refer to *Preservation Brief #1: The Cleaning and Waterproof Coating of Masonry Buildings*, and *Preservation Brief #38: Removing Graffiti from Historic Masonry.*)

Coatings: Concrete and Cement-like

Much attention has been given recently to the use of chemicals known as *consolidants*. Like many of the repellent coatings mentioned previously, consolidants form a molecular bond within the material to strengthen it against erosion. Consolidants are also said to allow the masonry to "breathe," thus eliminating the threat of trapped water vapor. (See sidebar.) The result has been considered successful in some recent tests, the majority of which have been conducted in temperate climates or controlled environments. Unfortunately, not enough is known of the long term impact of continued application of consolidants to recommend use in Minnesota's climate.

A Word of Caution: Water-Repellent Coatings

Though water-repellent coatings retard the penetration of water from exterior sources, they also inhibit the escape of trapped moisture from within. Many coatings form a shell through a molecular bond within the masonry. For the most part, the chemicals applied are inert, but they are also irreversible. The consequences, therefore, are long-range and in many cases disastrous. Allowed to freeze, the saturated masonry unit expands, forcing the outer surface to spall, or fracture, resulting in irreparable damage.



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Unlike stone or brick, concrete is a composite mix of sand or gravel (aggregate) bound together with cement. When water is added, the mix undergoes a chemical reaction and hardens. Concrete is especially vulnerable to freezing and thawing, as it readily absorbs moisture. Resulting problems include spalling of the surface, structural cracks from uneven settling or expansion, efflorescence or staining, and corrosion of structural reinforcing members.

It's Okay to Ask for Help

Once a problem is identified, remedial work usually requires a professional, not a “do-it-yourselfer.” Patching repairs require the total removal of deteriorated materials down to a sound substrate. For narrow cracks, a slurry of water and cement can be applied as filler. However, if the cracks are the result of settling, an elastic sealant must be used. Large areas require a patch of cement and sand to allow adequate compacting and bonding. If the patch is deep, several layers may be required. Care must be taken to assure that exposed reinforcing members are totally covered. It is highly likely that the concrete patch will not match the historic material; if repairs are extensive, it may be necessary to paint the surfaces with a special masonry paint for aesthetic reasons. (For further information, refer to *Preservation Brief #15: Preservation of Historic Concrete: Problems and General Approaches.*)

Stucco

Many concrete and tile buildings have stucco applied to their exteriors. Stucco is a two-or-three-part, plaster-like coating that is applied directly onto masonry or over wood or metal lath in frame construction. Though it is considered a *protective*



SHPO, MHS; photograph by Charles Nelson

Stucco applied to limestone has trapped moisture in the wall. Freezing caused the stucco to loosen and break away, taking bits of the stone with it.

coating, it is particularly susceptible to water damage. Successful repair requires an experienced professional plasterer. Stucco finishes are found in a variety of textures, ranging from smooth (like plaster) to heavily textured, “pebble-dash,” exposed aggregate (i.e., it looks like pebbles imbedded in cement). Areas to be repaired must be well-prepared by removing deteriorated stucco down to the substrate or lath, then layering the new stucco back to the required thickness and finishing its surface to match. In some cases where there has been extensive surface damage or deterioration, but the substrate remains sound, it may be desirable simply to apply a new finish coat to the entire building. (For further information, refer to *Preservation Brief #22: The Preservation and Repair of Historic Stucco.*)

Finally, a word of caution regarding improper use of cement-like coatings such as *dryvit* and *gunnite*. These coatings are commonly applied over deteriorated masonry in an effort to reestablish a sound exterior surface. Unfortunately, they are high in Portland cement content, and so do not have the same expansion properties as the masonry beneath. They form strong bonds to the masonry; if removed, they often cause damage to it, and also retard escape of trapped moisture in the wall. For these reasons, using these products on historic masonry buildings is strongly discouraged.



SHPO, MHS; photograph by Charles Nelson

Surface coating that traps moisture can cause extensive damage to masonry.

