STRUCTURAL ELEMENTS

Issues

The repair and restoration requirements for elements like walls, tombs, vaults, larger monuments, plot edging, etc., are different than for grave markers. Most of these are constructed of a number of smaller components.

The principle underlying all conservation work is the retardation of the natural process of decay in a manner that does not cause any other sort of harm. Water penetration, combined with freeze/thaw movement, is the major cause of damage encountered today. Horizontal and vertical structures exposed to the weather are susceptible to a gradual infiltration of moisture and frost with subsequent damage in the form of movement and deterioration of porous elements like mortar, brick and concrete. It has been observed that structures made up of large stones withstand the punishment from weather much better than structures built of smaller elements.

Stone and concrete cap details are often inadequate to prevent water intrusion and/or they were built without sufficient allowance for differential movement. The introduction of roofing and flashing materials on historic masonry is often inappropriate, impractical and in many cases impossible.

Recommendations

No repair that has been made should be regarded as permanent because the original construction was often inappropriate for the intended purpose or dimensionally less ample than would be used today. Ongoing maintenance will be necessary because unsheltered burial ground and cemetery structures will deteriorate rapidly without some form of protection from water penetration. Repairs on these sites should be considered an ongoing process, rather than "permanent" solutions, because the work involves historic components. The rate of natural deterioration can be slowed, but can not be completely stopped, as long as masonry and metals remain in their historic outdoor locations.

The overuse and over application of excessively hard mortars has been observed at most if not all of the sites. Virtually all of the original work involved the use of lime/sand mortar which predominated until about 1880. Although susceptible to washout, it was soft enough to allow bricks or stones some movement relative to each other. In a structure that lacks flexibility, stones and bricks break, mortar joints open and serious damage results. Cement mortars used after about 1880 were hard, creating strong and unyielding joints. They are appropriate to contemporary bricks and concrete blocks. Hard and soft building materials can not be used together effectively. Hard cement mortar will cause soft bricks and stones to spall and deteriorate.

Because these sites are located in a northern temperate climate, structural elements are subjected to a wide range of temperatures. This thermal stress requires regular examination and subsequent maintenance of structural elements. Inspect for cracked mortar, loose bricks, broken stones and other movement annually. Repair at least every 5 years.

Masonry Repair and Repointing

Issues

Repointing is probably the most common operation practiced in preserving and restoring old masonry structures. Improper repointing with soft mortars has been done on occasion in the past. But repointing that has been done since the introduction of hard cement mortar is more harmful. Repointing when badly done is difficult and expensive to correct. In extreme cases it causes irreparable damage to the physical structure as well as its appearance.

The clean, white appearance of lime tinted slightly by sand was a highly favored architectural effect. As a general rule, the color of the mortar used in historic structures in the United States depended on the color of the sand used in the mixture. White marble dust was sometimes added to mortar, replacing part or all of the sand, when pointing the joints between bricks and stones. Colored mortar, obtained by mixing in mineral or earth pigment like lampblack or Venetian red, was used sparingly. They are sometimes subject to fading. During the second half of the 19th century, dark mortar was popular. When colored to approximate brick, the narrow joints then fashionable contributed to create a continuity of wall surface effect.

Recommendations

Masonry repairs should be performed by experienced conservation professionals. When choosing the type of mortar to be used in repointing, full consideration must be given to matching the old mortar in color, texture, aggregate, strength and hardness [density and porosity]. The new mortar used in repointing should have the same physical characteristics as the old, only if the old mortar was reasonably appropriate in the first place. It is best to repoint with mortar having the same density and absorbency as the stones or bricks in a structure.

Masonry repairs should be performed with a mortar formulation that contains at least equal parts of cement and Type S hydrated lime for repointing. Lime mortars are both more compatible with brick masonry, and more flexible in conditions of thermal and moisture cycling. It is important that mortar used for routine pointing is compatible with the softness or hardness of a brick or stone. With long stretches of unrelieved wall, the mortar should be as soft as possible [for thermal expansion and contraction resiliency] with some hardness for durability. A type N mortar formulated just above the proportions used for type O would provide both of these characteristics. Use a color, aggregate and joint profile to harmonize visually with the adjacent work.

Perimeter walls and retaining walls need routine, periodic maintenance at least once every five years. All joints that have loose mortar should be repointed. All surfaces to be repointed should be properly prepared and cleaned, removing all loose and deteriorated mortar. Joints should be raked out by hand. The depth of chipping and raking should be at least twice the width of the joint to a maximum depth of 1-1/2". Care must be taken to avoid enlarging the width of joints. Mortar should be applied in lifts no greater than 1/2" at a time.

Masonry repairs should include repointing of all field stone walls. Where mortar that is deep inside the joints of a wall is soft, remedial work should include consideration of weep holes or other drainage devices. In addition, cavities should be packed with a material such as foam backer rods or the equivalent. Walls should be anchored to the work of adjacent materials where possible. Many walls remain standing despite incredible abuse and neglect simply because they possess some form of tie back.

Dry laid stone wall,
Old Burying Grounds, Littleton

Masonry repairs should be supervised by experienced professionals. Specific but broad comments relating to this topic are as follows:

- Never use premixed bagged mortar or grout. These materials are too hard. They will not accommodate movement of the masonry and in rare cases they may overstress the stone edge.
- Never point a bulged or leaning wall with hard mortar. This type of quick fix solution accelerates outward movement. Bowing is generally caused by earth pressure and/or mortar washout. Where possible and appropriate, use gravel backfill behind the wall and install weep holes.
- Masonry that has undergone excessive local movements should be rebuilt, not repointed. Do not exceed a joint width of 3/8" when rebuilding.
- Whenever possible, carry repointing below grade.
- Do not smear mortar on adjacent surfaces or on the joint being repaired.
- Where possible, tie thin elements together using stainless pins.
- Allow for large relative movements between concrete and brick. According to the Brick Institute of America, the thermal movement of concrete is more than double that of brick construction. Where possible and practical, install or cut drip edges in concrete caps to prevent moisture from entering mortar beds.

FOR REFERENCE

Removing Biological Growths

Issues

Some lichens and biological growths are acidic in nature or produce acids that can etch the surface or eat into stone, particularly porous stones like marble and limestone, in addition, to discoloring them. Some lichen penetrate stone causing microfractures. Others develop parallel with the stone surface and may be mechanically removed. It is possible that some protect the surface of stone reducing degradation from weathering.

Slate marker with biological growth,
Old Burial Ground, East Bridgewater

In general, the larger the population of certain types of growth above the stone surface, the more decay is caused below the surface, and thus the greater the need for removal. On the other hand, more damage is often incurred by removing these growths than the decay caused by them. Removal may be desirable but can result in considerable harm. Careless intervention can make the process of degradation more rapid. At the Botanic Garden of Ajuda in Lisbon, it was recently decided to leave botanic growths in place on a very important limestone balustrade rather than risk causing irreparable damage.

Recommendations

A stone conservator should determine the type and nature of biological growths and the condition of a stone prior to taking any action. If it is determined that it is a growth that can be removed without causing damage, a conservator may proceed with caution. Biological growths on the surface of markers should be removed **only** if the stone is stable to the touch. Only those older stones which have substantial moss or dark botanical growth should be cleaned.

One approach to removing some surface biological growths is dry brushing with a soft brush during dormant seasons. With great care, soft wood or flexible plastic scrapers may be tested, but care should be taken not to remove any surface grains of a stone, particularly if it is marble or sandstone. Another good conservative approach entails the use of copious wetting and neutral poultices.

It is possible to retard the harmful biological growth on historic markers. Seek the advice of a professional conservator for how that may best be done for any given stone and growth. Always be sure to have supervised testing of any material recommended before working on a whole stone.

After brushing and/or scraping, a biocide solution may be brush applied to retard recolonization and to remove exceedingly stubborn growths. Markers with stable surfaces may be brushed with a biocide solution and then washed gently.

Once every 5 years is a typical cycle of retreatment, but local conditions of exposure to vegetation, water and shade may suggest more or less frequent application.

Marble Protection

Issues

Marble components have generally deteriorated much more than the older slate components. Most of the white marble stones have lost surface detail due to acid rain and general weathering. A survey should be undertaken to identify and locate the most endangered marble markers at each site, designating those that still have legible inscriptions for immediate conservation. Many however are now illegible.

Recommendations

A long term plan should include selective conservation. Enough carved detail and lettering must remain legible to make a stone worth conserving. Where there is no legible lettering, conservation or consolidation is not advisable.

Do **not** treat stones with protective coatings that are impermeable to water vapor. These coatings can be very harmful to stones over time and others are ineffective.

Where brick walls require rebuilding, horizontal wire joint reinforcement and vertical reinforcing bars should be included in their reconstruction. Surface brick work should be performed so as to match surrounding brick work in every respect. Bricks should match in dimension, color, surface texture and gloss, hardness and absorption rate.

On masonry and stone fence or gate posts, the insertion points of horizontal metal fence rails should be repaired with appropriate pockets to take the metal inside the masonry or stone surfaces.

A concrete cap with expansion joints at ten feet on center with sealed contact edges is an acceptable alternative, but not as durable as lead coated copper flashing. In some locations consideration could be given to lead coping joint fillers like those made by Weathercap, Inc. of Slidell LA. While these joints have a slight crown that may be visually inappropriate, they offer long term durability.

Repointing weathered materials

Issues

Weathered bricks and stones in an old wall frequently acquire worn edges and rounded profiles. When repointing them it is advisable to recess the face of the new mortar slightly to keep the joint from becoming too wide and avoid spreading mortar over the edges of the bricks and stones. When repointing bricks and rubble, feather edges should be avoided. They break off easily, carrying particles of stone with them and leaving cavities through which moisture may enter.

Recommendations

The surface of an area that has been repointed or patched should be brushed so that some aggregate is raised before the mortar becomes hard. Alternatively, stippling the joint [marking it by touching it with the end of a stiff brush] before the mortar completely sets helps to give it a worn appearance. This surface texture retains a historic appearance and does not call as much attention to itself as a smooth mortar surface.

Mortared stone wall,
Old Burial Ground, East Bridgewater

Sealants

Issues

A sealant is a contemporary material that has been used in historic applications to prevent the intrusion of moisture.

Recommendations

The use of sealants should be limited because they are not visually compatible with the historic appearance of stone and masonry construction. Sealants also invade adjacent materials, making them extremely difficult to remove without removing some of the adjacent material. In addition, there is some degree of difficulty in controlling joint preparation and installation. Where sealants have been used, they are typically failing. It is preferable to use sealants only at expansion joints. In other locations, such as at a moving crack, they should only be used as a last resort. Caulking and sealing materials should not be used for repointing. Silicone sealants should not be used because of their tendency to absorb soil from soot and atmospheric pollutants. A fine aggregate can be applied to the surface of a sealant during the curing period to make it more closely match adjacent surfaces. Over time however, this aggregate has a tendency to erode away.

Sealant backings must be provided of preformed, compressible, resilient, nonwaxing, nonextruding strips of plastic foam or flexible, open cell polyurethane foam or nongassing, closed cell polyethylene, of a size, shape and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

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TOWN OF MONSON:

HILLSIDE CEMETERY STONE WALL REPAIRS Phase II

HILLSIDE CEMETERY MAIN STREET MONSON, MA

Architectural INSIGHTS
Architects Planners Interiors

3 Converse Street Palmer, MA 01069
413-283-2553 fax 413-289-8993
e-mail: admin@architectural-insights.com

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