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Journal

Brick Maintenance and Repair for Historic and Landmark Structures

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Historic and landmark brick structures demand meticulous investigation, organization, and skilled craftmanship to complete the job right — the first time around.

Durability is a hallmark of brick masonry construction, but even time-tested materials require maintenance to ensure long life. Managing a National Historic Register property or locally significant landmark may also mean negotiating regulatory restrictions, building codes, and community interests when considering how best to remediate deteriorating masonry. With all of these considerations, even a quality brick structure can feel more like a liability than an asset. But with the right strategy, masonry repairs need not overwhelm your schedule or your budget.

Coupling restoration strategies with contemporary technology, a qualified design professional can develop a rehabilitation and maintenance plan that accommodates individual financial, technical, and aesthetic considerations. And while deteriorated brick and mortar mean repairs, addressing the problem today will mitigate large-scale remediation tomorrow.

The First Step

Periodic comprehensive surveys of the building's exterior should be the foundation of any routine maintenance and repair plan. Maintenance personnel should familiarize themselves with the properties and expected performance of the exterior wall materials. Specifically, look for the following indications that brick masonry may be in need of maintenance or repair:

- efflorescence (a powdery residue on the brick surface; results from water-soluble salt deposits)
- spalling (missing or loose pieces of brick face)
- mortar joint deterioration (look for mortar that has softened, broken apart, or cracked)
- loose, cracked, or displaced bricks
- visible moisture damage (building interior or exterior)
- mold or plant growth on masonry surfaces

Early investigation into these conditions can prevent more costly future repairs. For example, small cracks in mortar can allow water to penetrate the joint. With each freeze-thaw cycle, the mortar further deteriorates, allowing more water to enter the wall system, further compounding the problem. Eventually, the mortar falls out, leaving loose (and possibly dangerous) brick. Thus, addressing seemingly minor issues is key to preventing the development of critical problems.

In the case of water infiltration, the apparent cause may be but one effect of

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the problem's true source. For instance, the symptom may be deteriorating mortar but the cause could actually be improperly installed copings or flashings or even a leaky roof, any of which could allow water to enter the wall system. Here, an experienced design professional can help the owner avoid another costly repair job in the future by correctly diagnosing the underlying problem.

A Thorough Investigation

Why do brick and mortar deteriorate? Some contributing factors architects look for include:

- excess moisture penetration at joints
- weathering, including exposure to successive freeze-thaw cycles
- contemporary conditions, such as pollution, not considered in the original building design
- uneven settlement of the building foundation
- thermal movement of masonry, especially at parapets
- unequal expansion/contraction of the face masonry with the backup (this can include re-anchored face brick when improper anchorage is used)
- capillary action causing rising damp (water drawn into the building materials from the ground up)

Often, a combination of factors may be the culprit in masonry deterioration. For a repair or maintenance effort to achieve lasting success, the plan must address underlying conditions before other repairs are initiated. Preventive measures should also be included in the overall action plan to limit or slow future deterioration.

With historic or landmark structures, special considerations may arise during the investigation. In order to avoid high-cost change orders and delays caused by unforeseen conditions, the design professional may need to research original construction documents and records of earlier repairs and building alterations. On-site observations complement this evaluation, as portions of the original documents may be unavailable, and building construction can deviate from that shown on plans. Test cuts, probes, photographs, and laboratory analysis may be part of this investigation.

If the building is a National Historic Register property or significant landmark, relevant regulatory issues also must be addressed as early as possible in the project. The process of gaining approval for construction can take time, so the design professional researches the necessary codes and regulations and initiates the process of obtaining required variances and endorsements during the initial investigatory phase.

Once historic commission and other regulations have been taken

Masonry Distress: Symptoms and Potential Causes

Observed Condition	Possible Source of Condition: Incompletely Filled Joints	Missing/Clogged Weep Holes	Plant Growth	Deteriorated Sealants	Capillary Rise	Missing/Damaged Flashing	Differential Movement	Previous Acid Cleaning	Previous Sandblasting	Previously Applied Surface Sealants
Cracking	●		●				●			
Spalling	●	●		●	●	●	●			●
Deteriorated Mortar	●	●	●		●	●	●	●	●	
Mildew/Algae Growth	●	●	●	●	●	●				●
Efflorescence	●	●		●	●	●		●		
Moisture-Related Stains	●	●		●	●	●				
Backing Material Corrosion	●	●		●	●	●		●		●
Damaged Interior Finishes	●	●		●	●	●	●			

into account, probable causes have been considered, and drawings and construction documents have been examined, a brick rehabilitation and maintenance program can be designed to meet the needs of a historic or landmark building. Generally, this includes establishing a scope of work, phasing, and budgeting.

Organizing the Work

In undertaking a brick repair, replacement, or repointing project, the job must be planned carefully and logically. Stabilizing the structure is top priority. Any hazardous conditions identified during the investigation, especially those that pose a danger to public safety, should be addressed immediately. Loose or severely deteriorated brick must be removed or held in place to prevent accidents.

Any such stabilization measures, however, should lay the groundwork for the rehabilitation effort. Care must be taken not to cause harm to the structure or to increase costs of subsequent work. For instance, it's common practice to secure dangerously loose brick with netting or screening until a more permanent solution can be implemented. But if improper anchorage was used in previous construction, removal may be sufficiently difficult as to further damage the building envelope.

Prior to the start of masonry remediation, underlying causes of water penetration must first be uncovered and corrected, or the work done will waste time and money. Proper sequencing can also help assure that new mortar and existing mortar weather similarly for better matching.

> "With the right strategy, masonry repairs need not overwhelm your schedule or your budget."

Thoughtful organization of repair work will minimize disruption and costs associated with erecting scaffolding and construction equipment.

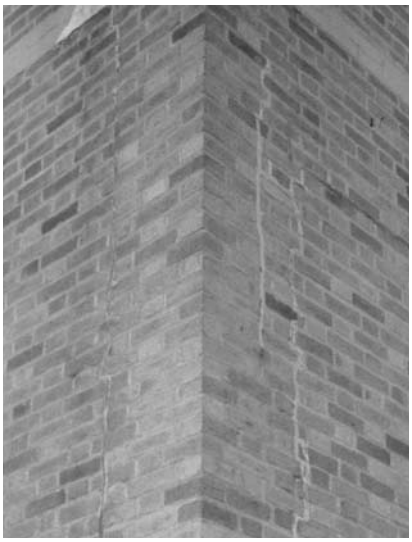
If budgeting permits, it makes economic sense to do all needed repairs at the same time to avoid incurring additional set-up costs. Scaffolding, sidewalk bridging, and other protective measures are expensive to take down and resurrect, and tenants will experience less disruption with only one construction period. Ideally, related roof and structural repairs should take advantage of scaffolding erected for brick work.

Addressing the root causes of masonry distress avoids wasting time and money on duplicate repairs. Here, replacing rusting steel supports before rebuilding the face brick provides a long-lasting solution.

In larger projects, correct phasing is essential to avoid damage to newly repaired sections when preparing the next portion of the work. For example, if cleaning is part of the program and the mortar joints are watertight, it makes sense to postpone repointing until after the building is cleaned. But if mortar is eroded badly enough to allow water penetration, repointing would need to be completed first.

A prime consideration in planning the repointing or replacement phase of a masonry rehabilitation project is the weather. Masonry surface temperatures should remain fairly moderate, so beginning the work in very cold or very hot, dry weather is not advisable.

Without detailed and exacting construction documents, there is no assurance that the often extensive time required to prepare and restore historic brick structures will be well spent. Skilled hand labor and custom mortar mixes may be needed to



Signs and symptoms of masonry distress include: (*starting at left, top to bottom*) efflorescence, displaced brick, surface spalling, (*at right, top to bottom*) interior water damage, deteriorated mortar, and cracking at building corners.

appropriately repoint or rebuild deteriorated masonry. While a thorough investigation is essential to identify underlying problems and prioritize repair work, only specific construction documents and drawings can provide details of proposed solutions. On-site project representation and construction administration can then help insure that the brick rehabilitation program is being implemented as designed.

Quick Fix?

Repointing, repair, rebuilding, and replacement of brick masonry on a historic or landmark structure can be time-consuming, noisy, dust-producing work, with scaffolding covering the building façade for some time. It can be tempting to look for a fast, easy solution. Once the investigation survey report identifies problem sites, "band-aid" repairs such as application of water repellant coatings might seem to take care of the problem. If the building is designed for mortar, though, it's best to stick with mortar. When moisture does find its way behind brick masonry, it can work its way out through mortar joints. Properly designed brick masonry walls get wet and dry out. But if the joint is sealed, the trapped water will further break down the masonry, while the sealer hides this ongoing deterioration.

The investigation phase of a historic or landmark brick rehabilitation project may be longer than with modern construction, but this extra time is essential to uncover the root cause of the deterioration. Once the source problem is addressed, repair of the masonry may be a time-consuming and exacting process; replacement mortar and brick must visually match the original yet be resilient enough for contemporary conditions. Is all of this extra time and effort necessary? If done well, masonry rehabilitation can restore the structural and aesthetic character of a building. If done improperly, a repair project can not only detract from the building's appearance, it can cause lasting harm to the masonry.

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Masonry Repointing Primer

What is Repointing?

Repointing, also called "pointing" or "tuck pointing," is the process of removing deteriorated mortar from joints and replacing it with new mortar.

When to Repoint

Some indications that repointing is necessary include:

- eroded mortar (a quarter of an inch or more from the masonry face)
- crumbled mortar
- hairline cracks
- broken bond between mortar and masonry

Repointing should be done only after underlying issues, such as leaking roofs, differential settlement of the building, unmitigated weather exposure, or rising capillary moisture have been addressed. Otherwise, the problem will soon recur, wasting time and money on multiple repairs.

How to Repoint

Examining the Pointing Style

To maintain the aesthetic quality of a historic or landmark building, it is necessary to examine the original techniques used in masonry construction. Pointing styles on both horizontal and vertical joints must be carefully noted, as these may differ, as might those on the different facades. Replicating original techniques as closely as possible will minimize visual discrepancies between newly repointed sections and those with original mortar intact.

Preparing the Joint

Old mortar should be removed to a depth of at least twice the joint width, or until sound mortar is reached. In historic structures with thin mortar joints, the power tools typically used for this purpose can damage the masonry units by overcutting. Hand chisels and, when necessary, small pneumatic grinders, present the least threat to masonry units. Loose mortar must then be flushed or brushed from the joint.

Preparing the Mortar

Repointing mortar should be carefully selected and properly proportioned. Where possible, the original mortar components and proportions should be duplicated. It is helpful to examine existing mortar which has not been exposed to weather, and then to match color and texture using several preparations which have been allowed to dry.

Workers inject mortar into the thin joints of a historic building.

When specifying a repointing mortar mix, architects look not only to create a uniform appearance between original and newly repointed wall sections, but also to select a mortar that will perform well over time. High-cement mortars don't have the flexibility and waterproofing quality of higher-lime mortars; mortar that is too hard could cause the brick to spall at the edge if movement occurs. Ideally, mortar should look like the original but be sufficiently yielding that hairline cracks become virtually self-sealing.

Filling the Joint

Once mortar has been selected and the joint prepared, mortar should be prehydrated and then packed into the joint in thin layers. Because most mortar shrinkage occurs during the hardening process, allowing each layer time to harden before the next is applied minimizes overall shrinkage.

Tooling the Joint

When mortar is firm, joints should be tooled to the original profile. This is especially important if only portions of a wall area are to be repointed. If old bricks have worn, rounded edges, it's best to recess the final mortar slightly from the brick face. Not only does this treatment keep new joints from appearing wider than existing ones, it also avoids creating thin feather-edges which can break off easily and so admit water.

Cleaning

Once the mortar has dried but not yet fully set, a stiff nylon or natural bristle brush may be used to remove excess mortar (metal bristles should be avoided with historic brick structures). If further cleaning is required, plain water is best, as chemical cleaners can damage masonry if not used properly. Repointed joints are particularly susceptible, because they do not fully cure for months. Washing with water before and after the use of chemical cleaners can help to avoid damage. ■

Glossary of Terms for Historic and Landmark Brick Rehabilitation Projects

Admixtures – Materials added to mortar to affect its properties.

Backup – That part of a masonry wall behind the exterior facing.

Belt Course – A narrow horizontal course of masonry. Sometimes called *string course* or *sill course*.

Bond Course – The course consisting of units which overlap more than one wythe of masonry.

Brick – A solid masonry unit of clay or shale fired in a kiln.

Collar Joint – The vertical, longitudinal joint between wythes of masonry.

Coping – The material or masonry units forming a cap or finish on top of a wall, pier, pilaster, chimney, etc. It protects masonry below from penetration of water from above.

Corbel – A shelf or ledge formed by projecting successive courses of masonry out from the face of the wall.

Course – One of the continuous horizontal layers of units, bonded with mortar in masonry.

Damp Course – A course or layer of impervious material which prevents capillary entrance of moisture from the ground or a lower course. Often called *damp check*.

Dampproofing – Prevention of moisture penetration by capillary action.

Efflorescence – A powder or stain sometimes found on the surface of masonry, resulting from deposition of water-soluble salts.

Face – The exposed surface of a wall or masonry unit.

Flashing – A thin, impervious material placed in mortar joints and through air spaces in masonry to prevent water penetration and/or provide water drainage.

Head Joint – The vertical mortar joint between ends of masonry units. Often called *cross joint*.

Header – A masonry unit which overlaps two or more adjacent wythes of masonry to tie them together. Often called *bonder*.

Laitance – A layer of weak and non-durable material containing cement and fines from aggregates, brought by bleeding water to the surface of overwet, over-trowelled mortar.

Lintel – A beam placed over an opening in a wall.

Masonry – Brick, stone, concrete, etc., or masonry combinations thereof, bonded with mortar.

Mortar – A plastic mixture of cementitious materials, fine aggregate and water.

Pointing – Troweling mortar into a joint after masonry units are laid.

Repointing – The filling in with fresh mortar of cut-out or defective mortar joints in masonry. Also called *tuck pointing*.

Slushed Joints – Vertical joints filled, after units are laid, by "throwing" mortar in with the edge of a trowel. (Generally, not recommended.)

Soffit – The underside of a beam, lintel or arch.

Spall – A small fragment removed from the face of a masonry unit by a blow or by action of the elements.

Struck Joint – A mortar joint which has been finished with a trowel.

Tooling – Compressing and shaping the face of a mortar joint with a special tool other than a trowel.

Veneer – A single wythe of masonry for facing purposes, not structurally bonded.

Wall – A vertical member of a structure whose horizontal dimension measured at right angles to the thickness exceeds three times its thickness.

Bearing Wall – One which supports a vertical load in addition to its own weight.

Cavity Wall – A wall built of masonry units so arranged as to provide a continuous air space within the wall (with or without insulating material).

Curtain Wall – An exterior non-load-bearing wall. Such walls may be anchored to columns, spandrel beams, floors, bearing walls, or backup walls, but not necessarily built between structural elements.

Parapet Wall – That part of a wall above the roof line.

Solid Masonry Wall – A wall built of solid masonry units, laid contiguously, with joints between units completely filled with mortar or grout.

Veneered Wall – A wall having a facing of masonry units or other weather-resisting materials securely attached to the backing, but not so bonded as to intentionally exert common action under load.

Weep Holes – Openings placed in mortar joints of facing material at the level of flashing, to permit the escape of moisture.

Wythe – Each continuous vertical section of masonry one unit in thickness.

Portions of this glossary are courtesy of the Brick Industry Association (BIA).

representative projects

Historic and Landmark Brick Structures

For over thirty years, Hoffmann Architects has helped clients remedy brick masonry deterioration while negotiating the functional and aesthetic demands unique to historic and landmark structures. Beginning with a detailed investigation into the causes of masonry distress, our architects and engineers combine contemporary technology with time-honored craftsmanship to develop appropriate rehabilitation strategies. During construction, Hoffmann Architects offers full administration and management services to see the brick rehabilitation effort to a successful completion.

The following is a selection of Hoffmann Architects' brick masonry projects at unique and historic buildings. Many of these are national or local landmarks, requiring special considerations and approval processes.

Keiper Hall/Green Room Theater (1936) at Franklin & Marshall College in Lancaster, PA. *Masonry Restoration.*

25 Broad Street (1902) in New York, NY. *Exterior Rehabilitation.*

One Linden Place Condominiums (ca. 1895)
Hartford, Connecticut
Façade Rehabilitation

Tomlinson Middle School (1917)
Fairfield, Connecticut
Masonry Rehabilitation

Kings County Medical Center (1938)
Brooklyn, New York
Façade and Roof Rehabilitation

Church of St. Augustine (1928)
The French-American School (1941)
Larchmont, New York
Exterior Envelope Rehabilitation

Old Yale Boathouse (1911)
New Haven, Connecticut
Masonry Condition Evaluation

Long Wharf Maritime Center (1985)
New Haven, Connecticut
Brick Cavity Wall Flashing Repairs

Burr Hall (ca. 1890)
Eastern Connecticut State University
Willimantic, Connecticut
Complete Building Envelope Rehabilitation

Renwick Gallery (1859)
Smithsonian Institution
Washington, District of Columbia
Masonry Restoration

44 Morningside Drive (1905)
Columbia University
New York, New York
Building Envelope Rehabilitation

President's House
60 Morningside Drive (1912)
Columbia University
New York, New York
Leak Remediation and Exterior Renewal

48 Wall Street (1928)
New York, New York
Façade Repairs

811 Tenth Avenue, AT&T (1965)
New York, New York
Masonry Rehabilitation

High School for Health Professions and Human Services (1904)
New York, New York
Masonry Repairs and Exterior Rehabilitation

Public School 36 (ca. 1901) in Bronx, NY. *Masonry Facade Rehabilitation and Window Replacement.*

(continued from page 4)

Failing to match the width and tooling profile of mortar joints when repointing can result in dramatic differences between original and newly repointed sections.

While brick rehabilitation on a historic or landmark structure can be disruptive, the investment in proper techniques and materials means longer lasting solutions with minimal maintenance work on the horizon. A qualified design professional who understands the special problems found in older buildings can act as the building owner's or manager's advocate throughout the rehabilitation process. Though it may not be a "quick fix," a thoroughly researched and exactingly executed remediation program can ensure that budget and design objectives are satisfied, with minimal disruption to occupants and as efficient a schedule as possible.

Built to Last

Shortcuts and inexpertly conceived repairs not only diminish a historic or landmark building's aesthetic character, they can actually exacerbate deterioration — meaning more repairs. With careful maintenance, mortar joints can last many years, even fifty or more. A well-designed restoration project now can help to preserve the integrity of the entire structure later. ■

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