

JOURNAL

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Have You Checked Your Mortar Joints Lately?

Theodore F. Babbitt, AIA

Have you checked your building's mortar joints lately for cracks or crumbling mortar? Although loose or missing mortar means repairs, the good news is that it will cost a lot less to repair today than tomorrow.

Repointing, tuck-pointing and pointing are all terms for removing deteriorating mortar from joints and filling the space with fresh mortar. The process, which is usually complex, labor-intensive and expensive, is undertaken to protect the building from further deterioration by preventing water from infiltrating into the structure.

Why do mortar joints deteriorate?

- Excess moisture penetration at joints
- Successive freeze-thaw cycles
- Exposure to severe weather conditions and pollution
- Uneven settlement of the foundation of the building
- Thermal movement of masonry
- Unequal expansion/contraction of the face masonry with the backup.

Besides cracked or crumbling mortar, other signs of deterioration include:

As Director of Architectural Services, Mr. Babbitt oversees masonry, curtain wall and roof rehabilitation projects for Hoffmann Architects.

- Cracked brick or stone
- Efflorescence
- Loose bricks
- Missing/clogged weep holes
- Plant growth
- Spalled bricks and exfoliation on stone
- Water stains
- Water penetration into the building.

An obvious and often early sign of trouble is hairline cracks in the mortar where it has lost adhesion to the masonry. When this happens, the joint may no longer be watertight. Once water gets in behind the mortar, the destructive freeze-thaw cycle mentioned above begins. With each cycle the mortar deteriorates further and allows more water to come in. As more water gets in, the problem is compounded until the mortar crumbles and ultimately falls out.

Identifying the Problem

In checking the building's mortar joints, it should be noted that the actual visual decay may not be the underlying problem. That is, the *symptom* may be crumbling mortar and loose bricks, but the *cause* may be faulty parapets or flashing or a leaky roof which are allowing water to enter the wall system. Unless the underlying cause is corrected before the repointing process is undertaken, the building's owner could well be faced with another expensive repointing job in the near future.

Estimated Life Expectancy of Materials Exposed to Normal Weathering

Material	Use	Estimated Life (years)
Brick	Walls	100 or more
Caulking	Sealer	8-10
Metal	Coping/Flashing	20-40
Mortar	Walls	25 or more
Plastic	Flashing	25 or more

Finishes

Paint	Waterproofing	3-5
Plaster	Waterproofing	3-5
Sealers	Dampproofing	1-5
Silicone	Dampproofing	1-5
Stucco	Waterproofing	3-5
Waxes	Waterproofing	1-5

A thorough inspection of the building is required to discover all underlying problems. It is best to start at the top of the building and work down. If there are leaks on the first floor of a 40-story structure, this exercise may be academic, but the roof, flashing and parapet still need to be checked. Because the coping stones on parapets, for example, are subject to excessive thermal movement and suffer the most damage from weather they need to be carefully checked.

At the ground, rising capillary moisture may be the culprit. Repointing this area may not provide a long-term solution, however, if the moisture problem is not corrected. Extensive settling of the building could also contribute to cracks in both the mortar and masonry.

Alternatives To Repointing

Depending on the condition of the masonry wall, an owner might try to avoid a full-scale repointing job by grouting the brick. In this procedure, brick is "masked" off and a coating of

grout is spread over the whole wall to fill all the hairline cracks. Once the procedure is complete, the mask is peeled from the wall. With glazed brick, the grouting may be applied without a mask so long as the brick face is thoroughly washed at the end of the procedure. This process should be used only if the mortar is sound.

Sometimes there is a temptation to use a sealant in joints rather than repointing them. If the building was originally designed for mortar, it is necessary to stay with mortar. If water does get in behind the stone or brick, it will work its way out through a mortar joint. But if the joint is sealed, the water will be trapped and will work its way inward rather than outward.

When To Repoint Masonry

Repointing is necessary when

- Mortar has eroded more than a quarter of an inch from the face of the masonry.
- Mortar has crumbled from the joint.

- Hairline cracks are apparent in the mortar.
- The bond between the masonry (brick, stone or concrete masonry unit) and the mortar is broken.

How To Repoint Masonry

In undertaking a repointing project, the job must be planned carefully and logically. A prime consideration is the weather because repointing should not be done in very cold weather or in very hot, dry weather. Masonry surface temperatures should remain within the 40 to 95 degree range. Weather presents a continual challenge: The day may be shirtsleeve temperature, but if the previous night was very cold, masonry, particularly on the north elevation, will take a long time to warm up. If the temperatures are too extreme, it is preferable to close the job down until the weather becomes more moderate.

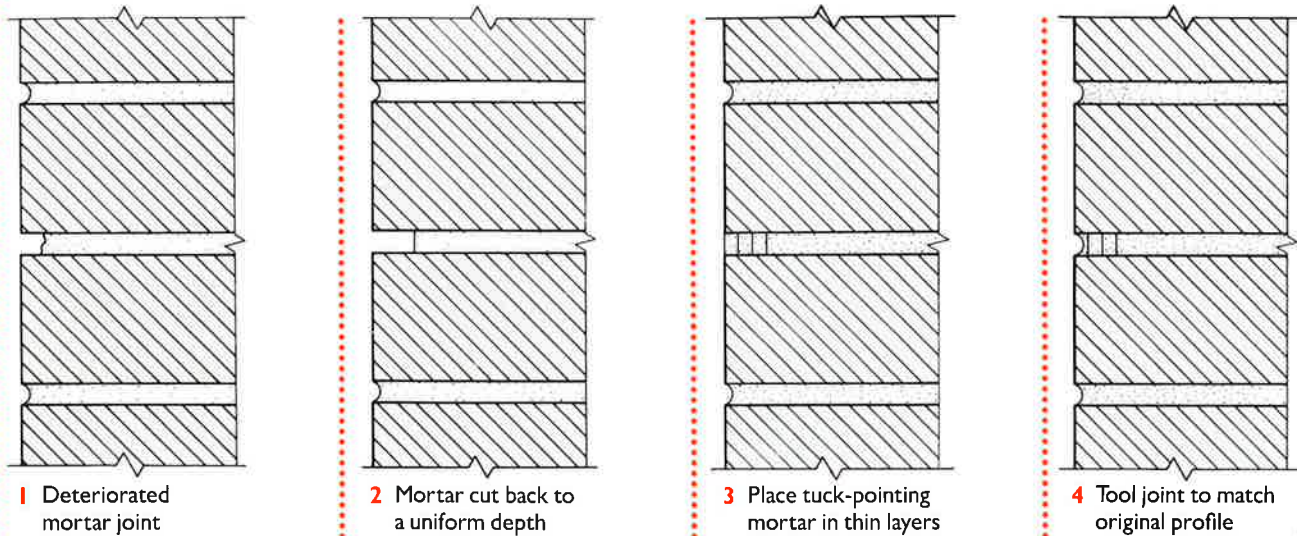
Another consideration in planning a repointing project is the sequence of work. As mentioned earlier, all under-

Possible Effects and Sources of Moisture Penetration

Sources of Moisture Penetration ▶										
	Previous Acid Cleaning	Previous Sandblasting	Plant Growth	Sealants/Caulks	Deteriorated Weepholes	Missing/Clogged Mortar Joints	Incompletely Filled Capillary Rise	Broken/Loose Units	Differential Movement	Missing Flashing
Effects of Moisture Penetration ▼										
Efflorescence		●		●	●	●	●	●	●	●
Deteriorated Mortar	●	●	●				●	●	●	
Spalled Units			●		●	●	●	●		●
Cracked Units					●	●	●	●	●	●
Rising Moisture						●		●		●
Corrosion of Back-up Materials	●				●	●	●	●	●	●
Mildew/Algae Growth	●				●	●	●	●	●	●
Damaged Interior Finishes	●				●	●	●	●	●	●

Courtesy / Brick Institute of America (BIA)

Tuck-Pointing Mortar Joints



lying causes of building deterioration and water penetration must be uncovered and corrected *prior to the start of the repointing portion of the job*. If water penetration is a problem, repointing should probably be done after all leaks are sealed. If the building to be cleaned is watertight, it might be better to repoint near the end of the job after the building is cleaned. That way, existing mortar and new mortar can weather simultaneously.

To open the joint, we recommend cutting out the old mortar to a depth of $\frac{5}{8}$ of an inch. If the mortar is still unsound at that depth, the cut should be made deeper. Old mortar can be removed with a small mason's chisel or a hand-held grinder. All loose mortar must be brushed or flushed from the joint. It is essential to avoid damaging the masonry when "raking" horizontal and vertical joints.

Matching Mortar

Matching existing mortar which has been exposed to the weather is almost impossible. The original mortar can be

duplicated through carefully selecting lime, sand or other aggregates. One way of doing this is to secure samples of the existing mortar which have not been exposed to the weather. These can be ground down and with the help of a magnifying glass, the sand or other aggregate can be seen and color matched. It is not like digging the sand out of the same gravel bank, but you can come very close to a color and texture match.

Trying to color match old mortar that has been left in place can be terribly difficult. It is like trying to match paint that has been on the office wall for two years: virtually impossible because a certain amount of dirt, grime and smoke has been picked up by the paint.

While matching the color and texture of the mortar is desirable, what is more important is that the mortar have a high lime content. Although high lime content mortar does not have the compressive strength of the usual Portland cement mortar, the lime adds a waterproofing quality and more flexibility to the joint.

If high lime mortar is used and water gets in through a hairline crack, it will mix with the lime and become almost self sealing. Mortar that is harder than the stone or brick should never be used because it would allow no flexibility in the joint and could cause the brick or stone to spall at the edge if movement occurs.

Matching Brick

Usually, it is not difficult to match brick when it needs to be replaced. Probably the biggest problem is to match glazed brick. Although replacement glazed brick may come out of the same factory as the original brick, it will not altogether match the original because the sheen on the original has faded.

Recycled bricks can be used, but great care must be taken in the selection process. In older buildings, two types of brick were often used. High-fired, long-lasting bricks were used on the exterior face, while low-fired bricks were used in areas where they would not be subjected to harsh weather conditions. If low-fired bricks are used on the exte-

rior face of a project, the brick could disintegrate within a few years and need to be replaced.

Filling the Joints

When undertaking a repointing project, the main concern is that all of the old, loose mortar has been cut out to the required depth and the joint is free of debris and dust. This is critical. Before new mortar is applied, the joint needs to be blown out with an air hose and the brick or stone needs to be wet so that it does not suck moisture out of the newly applied mortar.

Where existing mortar has been removed to a depth of greater than an inch, these deeper areas should be filled first, compacting the new mortar in several layers. The back of the entire

joint should be filled successively by applying approximately 1/4 inch of mortar, packing it well into the back corners. As soon as the mortar has reached thumb-print hardness, another 1/4 inch layer of mortar—approximately the same thickness—may be applied. Several layers will be needed to fill the joint flush with the outer surface of the brick. It is important to allow each layer time to harden before the next layer is applied; most of the mortar shrinkage occurs during the hardening process, and layering thus minimizes overall shrinkage.

Tooling the Joint

When the final layer of mortar is thumb-print hard, the joint should be tooled to match the original joint on the building. Mortar joints are classified as either

tooled or troweled. The tooled joint is preferred because it is watertight and more attractive. Proper timing of the tooling is important for uniform color and appearance. If tooled when too soft, the color will be lighter than expected. If it is tooled when too hard, there may be dark streaks called "tool burning," and good closure of the mortar against the brick will not be achieved.

If the old bricks have worn, rounded edges, it is usually best to recess the final mortar slightly from the face of the bricks. This treatment will help avoid a joint visually wider than the actual joint width; it will also avoid creation of a large, thin featheredge which is easily damaged, thus admitting water.

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Check For These Signs of Deterioration:

Courtesy / The Western Group (Western Waterproofing, Inc. and Brisk Waterproofing Company, Inc.)



Window Sealant

Cracked or open perimeter sealant; broken window putty or loose glazing gaskets.



Flashing

Holes or cracks in the flashing.



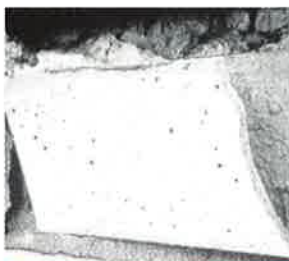
Building Corners

Vertical cracks close to each side of the building corners.



Masonry Walls

Cracks near window or door openings and/or in the general wall area.



Surface Spalling

Fragmentation or flaking of the masonry face.



Efflorescence

White powdery stains on the surface.



Mortar Joints

Deterioration or shrinkage-cracking.



Expansion Joints

Cracked, damaged or missing sealant.

Masonry Inspection Checklist

1 Masonry Walls

	North	South	East	West
Deteriorated Mortar Joints				
Cracked Units				
Efflorescence				
Loose Units				
Missing/Clogged Weepholes				
Plant Growth				
Deteriorated Sealants				
Out-of-Plumb Walls				
Failing Expansion Joints				
Surface Spalling				
Stains				
Water Penetration				
Vertical Cracks at Building Corners				

2 Windows

Deteriorated Sealants				
Rusting/Sagging Lintels				
Cracked/Spalled Sills				
Deteriorated Mullions				

3 Parapets

Damaged Parapet Caps				
Deteriorated Parapet Walls				

4 Flashing/Counterflashing

Bent Flashing				
Missing Flashing				
Open Lap Joints				
Stains				

5 Caps/Copings

Cracks				
Loose Joints				
Open Joints				
Displacement				

▶ **Checking Mortar Joints**

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The best type of tooling is a concave joint. In this type of joint the tool causing the concave shape forces mortar hard against the top and bottom of the brick. Obviously, there are many configurations, some of which are very difficult to match.

Cleaning

When cleaning brick, sandblasting should never be used, because it removes the outer surface of the brick, leaving it porous and susceptible to another cycle of deterioration.

The best way to clean brick or stone is with water. A continuous small stream of water is run down the face of the wall for up to 24 hours and then water applied under pressure is used to clean the wall. If there is a stain, something a little stronger may be used, but it is important not to use abrasives on the masonry.

In summary, the repointing of a masonry structure should never be undertaken until the root cause of the deterioration is discovered and corrected. But once the underlying problems have been resolved, the building should be repointed as soon as possible. Although repointing is expensive, it is even more costly to delay it by allowing excess moisture penetration to cause further erosion of building systems.

The best defense against extensive masonry deterioration and the high costs of repointing is a comprehensive inspection and maintenance program designed to prevent problems before they occur. ■

The Facility Manager's Bookshelf: **Repointing Mortar Joints**

A. Basic References

1. **Technical Notes on Brick Construction.** Brick Institute of America. \$65.00 per set, includes subscription to updates.

To order:

Masonry Institute of Connecticut
500 Main Street
Yalesville, CT 06492-1782
(203) 265-4431

2. ASCE/ACI 530. Joint Committee Report on Proposed Standards. **Building Code Requirements for Masonry Structures and Specifications for Masonry Structures.** ISBN 0-87262-631-8. 1988. Also available from the Masonry Institute of Connecticut.

3. **Masonry Mortar Technical Note Series.** National Lime Association. \$5.00 plus postage.

To order:

National Lime Association
3601 North Fairfax Drive
Arlington, VA 22201
Phone: (703) 243-LIME
FAX: (703) 243-5489

B. General Reading

Beall, Christine. **Masonry Design & Detailing: for Architects, Engineers, & Builders.** 2d ed. 512p. 1987. Paperback text ed. \$49.50. ISBN 0-07-004223-3. McGraw-Hill Publishing Co.

London, Mark. **How to Care for Old & Historic Brick & Stone.** Respectful Rehabilitation Series. Illustrated. 208p. 1988 paperback. \$12.95. ISBN 0-89133-125-5. Preservation Press.

Mack, Robert C., de Teel Patterson Tiller, and James S. Askins. "Repointing Mortar Joints in Historic Brick Buildings: A Procedural Guide." 1980. Preservation Brief #2, National Park Service. To place a credit card order, call the Government Printing Office at (202) 783-3238 and order GPO Stock Number 024-005-00878-1. Price \$1.00. A later version of this same article appeared in the **Construction Specifier**, June 1980, page 35.

Stockbridge, Jerry G. "Finding the best way to repair mortar joints." **The Magazine of Masonry Construction.** June 1988, page 112.

"Tuckpointing." **Concrete Technology Today.** Vol. 7, No. 3, 1986, PL863B, Portland Cement Association, 5420 Old Orchard Road, Skokie, IL, 60076 (708) 966-6200.

"Tuckpointing old mortar joints." **The Magazine of Masonry Construction.** June 1988, page 116. ■

Compiled by Alan Eddy, Technical Librarian

REMINDER TO NEW YORK CITY BUILDING OWNERS AND MANAGERS:

LOCAL LAW #10 FACADE INSPECTION REPORTS MUST BE FILED BY 21 FEBRUARY 1992



REPRESENTATIVE PROJECTS

Masonry Facade Rehabilitation

Hoffmann Architects specializes in rehabilitating the exteriors of existing facilities.

A major portion of the firm's practice involves rehabilitation of masonry exteriors, including brick, limestone, terra cotta, marble and granite facades.

Its professional architects and engineers investigate existing conditions, specify quality materials, detail construction drawings and administer construction contracts for repointing, cleaning and repairing masonry surfaces.

Based on a structure's individual characteristics, the interaction of its various components, the type and extent of deterioration, life cycle costs and budget constraints, project managers resolve deterioration and water infiltration problems before more serious, irreversible damage can occur.



Atochem Building, Philadelphia, Pennsylvania

Hoffmann Architects has provided masonry facade rehabilitation services for the following prominent buildings:

100 Park Avenue
New York, New York
(Prudential Insurance Company of America)

Prentice-Hall Building
Englewood Cliffs, New Jersey
(Simon & Schuster Inc.)

International Building
New York, New York
(Rockefeller Center Management Corporation)

Atochem Building
(formerly **Pennwalt Building**)
Philadelphia, Pennsylvania
(The Flynn Company)

28 State Street
(**Bank of New England**)
Boston, Massachusetts
(Prudential Insurance Company of America)

Random House Building
New York, New York
(The Durst Organization)

Gillette Headquarters Building
Boston, Massachusetts
(The Gillette Company)

New Rochelle Towers
New Rochelle, New York
(The Chase Manhattan Bank, N.A.)

Chrysler Building
New York, New York
(Cushman & Wakefield, Inc.)



Whitehall Building, New York, New York

GE Building (formerly **RCA Building**)
New York, New York
(Rockefeller Center Management Corporation)

Mattatuck Museum Building
Waterbury, Connecticut
(Bank of Boston Connecticut)

Exxon Building
New York, New York
(Rockefeller Center Management Corporation)

310 Orange Street
New Haven, Connecticut
(Southern New England Telephone Company)

NYNEX Building
White Plains, New York
(NYNEX Properties Company)

Whitehall Building
New York, New York
(17 Battery Place North Associates) ■

Staff News

Professional Accomplishments:

BOMA New York's 1990 Annual Magazine included the following articles by Hoffmann Architects staff: "Conventional Built-Up Roofing vs. Single Ply" by **Russell M. Sanders, AIA**; "Preventing Reinforcement Corrosion in Parking Garages" by **John J. Hoffmann, AIA**; "A Quality Roof: Your Best Insurance Coverage" by **Alan P. Eddy** and "How to Spot Distress in Masonry Structures" by the Technical Staff of Hoffmann Architects.

Charles D. Fleischman, PE chairs BOMA Hartford's Video Workshop Series on Roofing, Commercial Property Inspection, Landscaping, HVAC and Vertical Transportation.

John D. Kennedy served as an instructor in BOMA Southern Connecticut's newly developed RPA Program.

Alan P. Eddy has been certified by the Construction Specifications Institute as a Construction Documents Technologist. His column appears monthly in the CSI Housatonic Chapter's newsletter.

Jane B. Beaudry was elected to the Board of Directors of the Housatonic Chapter of the Construction Specifications Institute. She will also serve as Editor of the chapter's newsletter.

Roy C. Olsen, AIA, CSI was elected Treasurer of the Housatonic Chapter of Construction Specifications Institute.

Ann M. Prokop was appointed Public Relations Chairperson of the Southern New England Chapter of the Society for Marketing Professional Services.

Richard P. Kadlubowski has been appointed CSA Associates Commissioner by the Connecticut Society of Architects. He served as Co-Chairman of the 1990 CSA/AIA Beaux Arts Ball.

The New Haven/Bridgeport Chapter of the Association of Records Managers and Administrators elected **Alan P. Eddy** Vice President.

New Staff:

Hoffmann Architects is pleased to introduce the following new staff members: **Hoa Giang**, Project Representative/Drafter; **Robert C. Hale**, Project Representative/Drafter; **Marcus C. Long**, Technical Assistant; **Roy C. Olsen, AIA**, Project Architect.

John C. Butters, AIA, Senior Architect, manages the New York City office of Hoffmann Architects. **Nicholas Agneta, RA** serves as Senior Project Representative, and **Wilson Ng** as Project Representative/Drafter. ■

JOURNAL is a publication of Hoffmann Architects, specialists in investigative and rehabilitative architectural/engineering, including the analysis and solution of problems within roofs, exterior walls, glazing and structural systems of existing buildings, plazas and parking garages.

Please send news, technical information, address changes or requests for free subscriptions to Ann Prokop, Editor, Hoffmann Architects/*JOURNAL* at 432 Washington Avenue, North Haven, Connecticut 06473.

For answers to specific questions or for information on the services we offer, please call Brian Schafer at (203) 239-6660.