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Maintenance of Brick Masonry

Abstract: Even though one of the major advantages of brick masonry construction is durability, periodic inspections and maintenance can extend the life of brickwork in structures. This *Technical Note* discusses the benefits and elements of suggested inspection programs and describes specific maintenance procedures including replacement of sealant joints, grouting of mortar joint faces, repointing of mortar joints, removal of plant growth, repair of weeps, replacement of brick, installation of a dampproof course, installation of flashing in existing walls and replacement of wall ties.

Key Words: anchors, cleaning, dampproof course, efflorescence, flashing, inspection, maintenance, moisture penetration, mortar, repointing, sealant, ties, weeps.

SUMMARY OF RECOMMENDATIONS:

- Perform periodic inspections, preferably each season
- Determine moisture source before attempting repairs to correct moisture penetration
- Remove and replace torn, deteriorated or inelastic sealants
- When repairing mortar joints, surface grout hairline cracks and repoint damaged or deteriorating mortar joints
- Repoint with prehydrated Type N, O or K mortar, mixed drier than for conventional masonry work
- Remove ivy and plant growth that contributes to moisture penetration or deterioration of brickwork
- Exercise care in opening existing or drilling new weeps, to ensure that flashing is not damaged
- Install a dampproof course if missing or required
- Install remedial anchors and ties in accordance with manufacturer's recommendations
- Inspect masonry and correct all deficiencies before application of external coatings

INTRODUCTION

This *Technical Note* discusses maintenance of brick masonry with an emphasis on preventing moisture penetration. All buildings are unique and may experience different problems. A given solution may not remedy similar problems on all buildings. It is therefore suggested that a repair method which will effectively suit the particular needs of a building be selected when a problem occurs.

Generally, if brickwork is properly designed, detailed and constructed, it is very durable and requires little maintenance. However, many of the other components incorporated in the brickwork such as caps, copings, sills, lintels and sealant joints may require periodic inspection and repair. Neglecting maintenance of these components may lead to deterioration of other elements in the wall.

Maintenance of buildings may be broken into two general categories: 1) general inspection to identify potential problems with the performance of exterior walls; and 2) specific maintenance to correct problems which may develop. This *Technical Note* addresses both general and specific maintenance procedures. A checklist is provided for general inspections and specific repair techniques are described.

GENERAL INSPECTION

A thorough inspection and maintenance program may help extend the life of a building. It is a good idea to become familiar with the materials used in a building and how they perform over a given time period. Table 1 lists various building materials and the estimated time before repair may be needed, given normal exposure. These times are based on brickwork in vertical applications, constructed of proper materials and workmanship and exposed to normal weathering conditions in the United States. Sills, parapets, chimneys and copings which experience more severe exposures may require repairs at shorter intervals.

Periodic inspections should be performed to determine

TABLE 1

Estimated Time to Repair of Materials

Material	Use	Estimated Time to Repair (Years)
Brick	Walls	100+
Sealant	Joints	5-20
Metal	Coping/Flashing	20-75
Metal	Anchors & Ties	15+
Mortar	Walls	25+
Plastic	Flashing	5-25
Finishes		
Paint	Appearance	3-5
Water Repellents	Dampproofing	5-10
Stucco	Appearance	5-10

the condition of the various materials used on a building. These inspections can be performed monthly, yearly, biennially, or any time period deemed appropriate. “Seasonal” inspection periods are recommended so that the behavior of building materials in various weather conditions can be noted. Inspection records, including conditions and comments, should be kept to identify changes in materials, potential problems and needed repair. Table 2 is a suggested checklist of conditions that may require maintenance or repair. It is not all-inclusive; however, it may establish a guideline for use during inspections.

Conditions that may necessitate maintenance or repair actions include efflorescence, spalling, deteriorating mortar joints, interior moisture damage and mold. Once one or more of these conditions becomes evident, the origin of the problem should be determined and action taken to correct both the cause and visible effect of the condition. Table 3 lists various conditions affecting brickwork and their most probable sources. The items checked in the table represent each source that should be considered when such conditions are observed in brick masonry.

TABLE 2

Brick Masonry Inspection Checklist

LOCATION		ITEM OR CONDITION	BUILDING ELEVATION			
			NORTH	SOUTH	EAST	WEST
Above Grade	Masonry	Cracked Units				
		Loose Units				
		Spalled Units				
		Hairline Cracks in Mortar				
		Deteriorated Mortar Joints				
		Missing or Clogged Weeps				
		Plant Growth				
		Deteriorated/Torn Sealants				
		Out-of-Plumb				
		Efflorescence				
		Stains				
		Water Penetration				
	Flashing/ Counter-flashing	Damaged				
		Open Lap Joints				
		Missing				
		Stains				
	Caps/ Copings/ Sills	Inadequate Slope				
		Cracked Units				
		Hairline Cracks in Mortar				
		Loose Joints				
		Open Joints				
		Out-of-Plumb				
		Drips Needed				
Below Grade	Foundation Walls	Deteriorated Mortar Joints				
		Cracks				
		Separation from Flooring				
		Inadequate Drainage				
		Water Penetration				
	Retaining Walls	Spalled Units				
		Deteriorated Mortar Joints				
		Cracks				
		Out-of-Plumb				
		Dampness				
		Inadequate Drainage				
	Other Elements	Roof Overhangs				
		Gutters/Leaders				
		Seal at Adjacent Materials				
		Grade/Drainage				

SPECIFIC MAINTENANCE

After investigating all of the possible contributors the actual cause(s) of distress conditions may be determined through the process of elimination. Often the source will be self-evident as with deteriorated and missing materials; however, in instances such as improper flashing or differential movement the source may be hidden and determined only through building diagnostics. In any case, it is suggested to first visually inspect for the self-evident source before performing a more extensive investigation as it may save time and money in detecting the cause. Such a process should always be followed if the condition involves water penetration. Once the source is determined, measures can be taken to effectively remedy the moisture penetration source and its effects on the brickwork.

TABLE 3

Possible Sources and Effects of Masonry Distress

Observed Condition \ Potential Cause of Condition	Incompletely Filled Mortar Joints See *Technical Note* 7B	Missing/Clogged Weeps	Plant Growth	Deteriorated/Torn Sealants	Capillary Rise	Missing/Damaged Flashing See *Technical Notes* 7 Series	Differential Movement See *Technical Notes* 18 Series	Previous Acid Cleaning See *Technical Note* 20	Previous Sandblasting See *Technical Note* 20
Cracked Units	■		■				■		
Spalled Units	■	■		■	■	■	■		
Deteriorated Mortar	■	■	■		■	■	■	■	■
Mildew/Algae Growth	■	■	■	■	■	■			
Efflorescence See TN 23 Series	■	■		■	■	■		■	
Moisture Related Stains	■	■		■	■	■			
Corrosion of Backing Materials	■	■		■	■	■		■	
Damaged Interior Finshes	■	■		■	■	■	■		

Removing Efflorescence

Generally, efflorescence is water-soluble and easily removed by natural weathering or by scrubbing with a brush and water. Proprietary cleaners formulated specifically for use on brickwork are effective in removing stubborn efflorescence (see *Technical Note* 20).

Use solutions specifically manufactured to remove efflorescence from brickwork. Improper acid cleaning procedures such as insufficient prewetting, rinsing and strong acid concentrations may cause additional staining, etched mortar joints and increase moisture penetration in brickwork. Stains caused by improper cleaning are not water-soluble, but can be removed by proprietary cleaners.

All cleaning procedures should first be tried at different concentrations in an inconspicuous area to judge their effectiveness and potential harm to the brickwork. Additional recommendations and cleaning methods for brick masonry are presented in *Technical Note* 20. After cleaning, the mortar joints should be inspected. Repointing or grouting of the joints, as discussed later in this *Technical Note*, may be necessary.

Sealant Replacement

Missing or deteriorated sealants in and between brickwork and other materials such as windows, door frames and expansion joints may be a source of moisture penetration. The sealant joints in these areas should be inspected closely to discover areas where the sealant is missing, or was installed but has deteriorated, torn or lost elasticity. Deteriorated sealants should be carefully cut out and the opening cleaned of all existing sealant material. The clean joint should then be properly primed and filled with a backer rod (bond breaker tape if the joint is too small to accommodate a backer rod) and a full bead of high-quality, elastic sealant compatible with adjacent materials.

Mortar Joint Repair

Repair of cracked or deteriorating mortar joints is very effective in reducing the amount of water that enters exterior masonry. Cracks in brickwork that are more than a few millimeters in width or that are suspected to have been caused by settlement or other structural problems (for example, cracks that continue through multiple brick units and mortar joints, or follow a stepped or diagonal pattern along mortar joint) are beyond the scope of this *Technical Note*. These cracks often require professional investigation to determine the cause and appropriate method of repair.

Grouting of Hairline Cracks. If the mortar joints develop small “hairline” cracks, surface grouting may be an effective measure to fill them. The impact of surface grouting on brickwork aesthetics should be considered before work begins as the appearance of the mortar joints will change somewhat. A recommended grout mixture is 1 part portland cement, ⅓ part hydrated lime and 1⅓ parts fine sand (passing a No. 30 sieve). The joints to be grouted should be dampened. To ensure good bond, the brickwork must absorb all surface water. Clean water is added to the dry ingredients to obtain a fluid consistency. The grout mixture should be applied to the joints with a stiff fiber brush to force the grout into the cracks. Two coats are usually required to effectively reduce moisture penetration. Tooling the joints after the grout application may help compact and force the grout into the cracks. The use of a template or masking tape may be effective in keeping the brick faces clean.

Repointing Mortar Joints. Moisture may penetrate mortar which has softened, deteriorated or developed visible

cracks, as shown in Photo 1. When this is the case, repointing (sometimes referred to as tuckpointing) may be necessary to reduce moisture penetration. Repointing is the process of removing damaged or deteriorated mortar to a uniform depth and placing new mortar in the joint, as shown in Photo 2 and Figure 1.

Prior to undertaking a repointing project, the following should be considered: 1) The potential for power tools to damage the brick surrounding the mortar being cut out. 2) Repointing operations should only be performed by qualified and experienced repointing craftsmen. An individual who is an excellent mason may not be a good repointing craftsman. Skills should be tested and evaluated prior to the selection of the contractor or craftsman. 3) When repointing for historic preservation purposes, refer to *Preservation Brief 2: Repointing Mortar Joints in Historic Masonry Buildings.* [Ref. 7]

The deteriorated mortar should be removed, by means of a toothing chisel or a special pointer's grinder, to a uniform depth (refer to Figure 1b) that is twice the joint width or until sound mortar is reached. Care must be taken not to damage the brick edges. Remove all dust and debris from the joint by brushing, blowing with air or rinsing with water.

Repointing mortar should be carefully selected and properly proportioned. For best results, the original mortar constituents and proportions should be duplicated. If this is not possible, select a mortar that is similar or lower in compressive strength. Type N, O and K mortar are generally recommended, as mortars with higher cement contents may be too strong for proper performance. Proper proportions for Type K mortars are 1 part portland cement, 4 parts hydrated lime and 11¼ to 15 parts fine sand. Refer to *Technical Note* 8 for material proportions of Type N and O mortar.

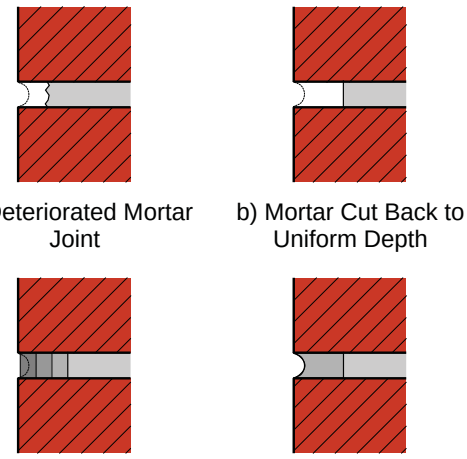
The repointing mortar should be prehydrated to reduce excessive shrinkage. The proper prehydration process is as follows: All dry ingredients should be thoroughly mixed. Only enough clean water should be added to the dry mix to produce a damp consistency which will retain its shape when formed into a ball. The mortar should be mixed to this dampened condition 1 to 1½ hr before adding water for placement.

The joints to be repointed should be dampened, but to ensure a good bond, the brickwork must absorb all surface water before repointing mortar is placed. Water should be added to the prehydrated mortar to bring it to a workable consistency (somewhat drier than conventional mortar). The mortar should be packed tightly into the joints in thin layers (¼ in. [6.4 mm] maximum), as shown in Figure 1c. The joints should be tooled to match the original profile after the last layer of mortar is "thumbprint" hard, as in Figure 1d. As it may be difficult to determine which joints allow moisture to penetrate, it is advisable to repoint all mortar joints in the affected wall area.

If only portions of the wall area are repointed, the repointing mortar should match the color of the existing mortar. Mortar materials should be mixed and the color matched to existing mortar that has been wetted. Several mix proportions can be made and placed on extra brick. Selection is made after the mortar specimens

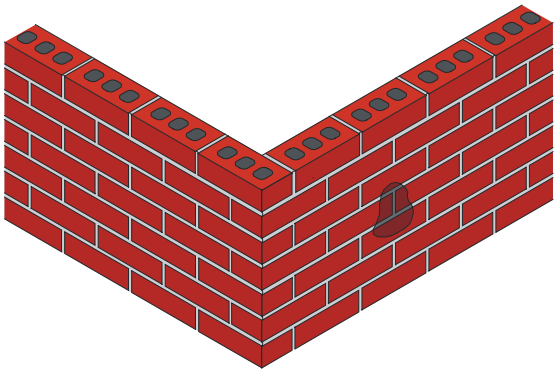
Photo 1
Mortar Joints in Need of Repointing

Photo 2
Repointing Mortar Joints

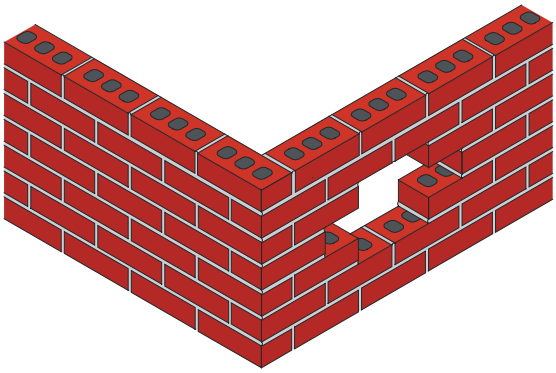


a) Deteriorated Mortar Joint
b) Mortar Cut Back to Uniform Depth
c) Pack Pointing Mortar in Thin Layers
d) Tool Joint to Match Original Profile

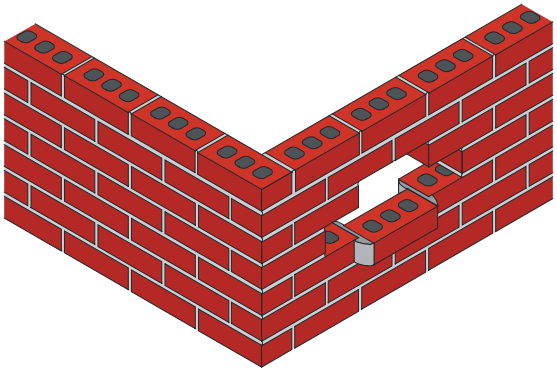
Figure 1
Repointing Mortar Joints



a) Damaged Brick



b) Remove Brick and Mortar



c) Butter Replacement Brick and Carefully Shove into Place

Figure 2
Replacement of Deteriorated Brick

are dried and compared to dry existing mortar.

Plant Removal

Certain types of plant growth may contribute to moisture penetration. For example, ivy shoots, sometimes referred to as "suckers", penetrate voids in mortar and may conduct moisture into these voids. If this is the case, ivy removal may be necessary.

To effectively remove ivy and similar plants, the vines should be carefully cut away from the wall. The vines should never be pulled from the wall as this could damage the brickwork. After cutting, the shoots will remain. These suckers should be left in the wall until they dry up and shrivel. This usually takes 2 to 3 weeks. Care should be taken not to allow the suckers to rot as this could make them difficult to remove. Once the shoots dry, the wall should be dampened and scrubbed with a stiff fiber brush and water. Laundry detergent or weed killer may be added to the water in small concentrations to aid in the removal of the shoots. If these additives are used, the wall must be thoroughly rinsed with clean water before and after scrubbing.

To determine how the wall will appear once the ivy is removed, it is suggested that a small portion of the ivy (5-10 ft² [0.5 to 1.0 m²]) be removed from an inconspicuous area first. Repointing of the mortar joints may be necessary if the mortar has cracked or deteriorated.

Opening Weeps

Weeps should be inspected to ensure that they are open and appropriately spaced so that moisture within the walls is able to escape to the exterior. If weeps are clogged, they can be cleaned out by probing with a thin dowel or stiff wire. If the weeps were not properly spaced, drilling new weeps may be necessary. *Technical Note* 7 outlines suggested types and spacing of weeps.

Since weeps are placed directly above flashing, care must be exercised to not damage the flashing when probing or drilling. The use of a stopper to limit the depth of penetration of the probe or drill bit may be effective in reducing the possibility of damaging the flashing where it turns up inside of the brick wythe.

Replacement of Brick

Moisture may penetrate brick that are broken or heavily spalled. When this occurs, it may be necessary to replace the affected units. The procedure shown in Figure 2 is suggested for removing and replacing brick.

The mortar that surrounds the affected units should be cut out carefully to avoid damaging adjacent brickwork, as shown in Figure 2b. For ease of removal, the brick to be removed can be broken. Once the units are removed, all of the surrounding mortar should be carefully chiseled out, and all dust and debris should be swept out with a brush. If the units are located in the exterior wythe of a drainage wall, care must be exercised to prevent debris from falling into the air space, which could block weeps and interfere with moisture drainage.

The brick surfaces in the wall should be dampened before new units are placed, but the masonry should absorb all surface moisture to ensure a good bond. The appropriate surfaces of the surrounding brickwork and the

replacement brick should be buttered with mortar. The replacement brick should be centered in the opening and pressed into position, refer to Figure 2c. The excess mortar should be removed with a trowel. Pointing around the replacement brick will help to ensure full head and bed joints. When the mortar becomes “thumbprint” hard, the joints should be tooled to match the original profile.

Mortar proportions are selected as discussed in the section on Repointing. Matching the existing mortar color is important to keep the replacement location from being different in appearance. Similarly, replacement brick must match the color, texture and size of the existing brick. Locating a matching brick may take considerable effort.

Installation of a Dampproof Course

Moisture may migrate upward through brickwork by capillary action. This condition appears as a rising water line or “tide mark” on the wall and is referred to as “rising damp”.

Model building codes require the use of a dampproofing material on below grade masonry walls and flashing above grade. If these are omitted or improperly installed, rising damp may occur. The insertion of a dampproof course at a level above the ground, but below the first floor, may stop the rising moisture. The installation procedure can take one of two forms. One form is the injection of a synthetic chemical that forms a continuous dampproof barrier into an existing brick course. Holes are drilled into the course of brick and the synthetic material is injected. The other form of installation is the insertion of flashing through the brick wythe. One or more brick courses are removed, flashing is inserted, and the brick is replaced. Recommendations for brick removal and replacement are discussed in the following section.

Installation of Flashing

Flashing that has been omitted, damaged or improperly installed may permit moisture to penetrate to the building interior. If this is the case, a difficult procedure of removing brick, installing flashing and replacing the units may be required.

Photo 3
Flashing Installed in Alternating Sections

Photo 4
Flashing Installation Using Temporary Support

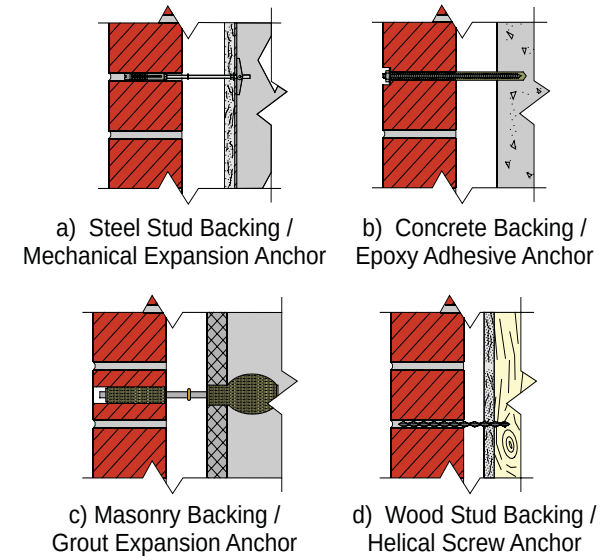


Figure 3
Masonry Re-Anchoring Systems

To install continuous flashing in existing walls, alternate sections of masonry in 2 to 5 ft (610 mm to 1.52 m) lengths should be removed. The flashing is installed in these sections and the masonry replaced, refer to Photo 3. Alternately, temporary braces can be installed as longer sections of brickwork are removed, as shown in Photo 4. The flashing can then be placed in these sections. The lengths of flashing should be lapped a minimum of 6 in. (152 mm) and be completely sealed to function properly. See *Technical Note* 7 for other flashing installation recommendations. The opening is then filled as discussed under Replacement of Brick. The replaced masonry should be properly cured (5 to 7 days) before the intermediate masonry sections or supports are removed.

Installation of Wall Ties and Anchors

In instances where masonry walls have been constructed without a sufficient number of connectors or the existing connectors have failed, “retrofit” anchors may be used to attach the wythes or veneer and transfer lateral loads. Installing anchors in such a wall improves its strength and reduces the potential for cracking. Installation of most retrofit anchors involves drilling small holes in the masonry, usually in a mortar joint, through which the anchors are attached to the substrate. Generally, mechanical expansion, helical screws, grout- or epoxy-adhesive systems, shown in Figure 3, are used to make the connection. Because the installation methods and limitations of each product are unique, consultation with the manufacturer is essential to assure proper application, detailing, installation, inspection, and performance.

Coatings and Water Repellents

The use of external coatings on brick masonry should be considered only after completing repair and replacement of brick, mortar joints and other building elements, and careful consideration of the possible consequences. Properly designed and constructed brickwork can be expected to satisfactorily resist water penetration without the application of water repellents or external coatings. However, they may be used successfully to correct some deficiencies. For example, some coatings are helpful in reducing the amount of water absorbed by barrier walls and masonry subject to extreme exposures such as chimneys, parapets, copings and sills.

External coatings are most effective in reducing water penetration when their intended use corresponds with the nature of the existing water penetration problem. Water repellents and coatings should not be considered equivalent to essential, code-required details that resist water penetration. Use of coatings for reasons outside their intended application rarely reduces water penetration and may lead to more serious problems.

Only water repellents that permit evaporation and the passage of water vapor, such as siloxanes and silanes, should be used on exterior brickwork. Film-forming coating should not be applied to exterior brickwork. *Technical Notes* 6 and 6A and manufacturer’s literature should be consulted before any coating is applied to brickwork.

SUMMARY

This *Technical Note* has presented maintenance procedures for brick masonry. Routine inspection of the building is suggested to determine the condition of the brickwork and related materials. If distress is noted, appropriate maintenance tasks should be performed. If the problem is moisture related, the source of moisture should be determined and corrected before other repairs are initiated.

> *The information and suggestions contained in this* Technical Note *are based on the available data and the combined experience of engineering staff and members of the Brick Industry Association. The information contained herein must be used in conjunction with good technical judgment and a basic understanding of the properties of brick masonry. Final decisions on the use of the information contained in this* Technical Note *are not within the purview of the Brick Industry Association and must rest with the project architect, engineer and owner.*

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