PERMACON

Technical Information Guide

Concrete Masonry Products

Contents

Introduction

For more than 70 years, Permacon has embodied innovation as well as a strong commitment to product quality, with our products meeting industry standards. Here are some of the standards that we adhere to:

> **Brick: CSA A165.2 – Architectural Concrete Brick**

> **Stone: CSA A165.1 – Architectural Concrete Stone**

The robust quality of concrete brick and stone ensures their durability over time especially given the harsh Canadian climate we live in. The natural wear and tear all buildings are subject to necessitates periodic repair and restoration work to preserve and maintain the exterior integrity and appearance. The characteristic wear and tear that all buildings are subjected to, however, necessitate periodic repair and restoration to preserve and maintain the original integrity and appearance of the structure. Preventive maintenance conserves the value, appearance and integrity of the building.

The life of a concrete masonry structure can be directly related to its quality of maintenance and an established and rigorous maintenance program can greatly reduce the chances of major issues and costly repairs. This document focuses on typical maintenance concerns facing owners of concrete masonry buildings.

This guide was developed with CMHA resources and technical documents.

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Design and Construction Considerations
TEK 08-01A

Design and construction methods greatly affect the required maintenance needs of a building. Accordingly, maintenance issues should be considered during the design and construction processes in advance of construction. Accepted industry practices should be followed to avoid cracking and spalling, preclude efflorescence, minimize staining and dirt buildup, and prevent the penetration of water into the structure. While design and construction issues are beyond the scope of this document, it is recommended referencing other industry guidelines during the design and construction of buildings as required.

Cleaning Concrete Masonry
TEK 08-02A and TEK 08-04A

Concrete masonry buildings offer exceptional beauty, coupled with attributes such as structural strength, durability, fire resistance, acoustic performance and low maintenance. Proper cleaning after construction and throughout the life of the building will help preserve concrete masonry's beauty.

Although the maintenance needs of a well designed and constructed masonry wall are minimal, contaminants, such as oil, grease, or other foreign substances, can detract from an otherwise attractive unpainted masonry structure.

Cleaning of mortar smears, construction dirt and possibly efflorescence from the construction phase is usually required. Subsequent cleaning may be required over the life of the building to address dirt and soot from the atmosphere or staining from specific sources. Appropriate cleaning can remove contaminants and help produce a more uniform appearance.

Periodic cleaning of buildings may be needed to remove dirt, stains, efflorescence, graffiti and mold. As a general recommendation for all cleaning efforts, care should be taken to use a cleaning method that is as delicate as possible so as not to damage the masonry or surrounding materials. The cleaning agent manufacturer's recommendations should be closely followed since some products can not only damage the building but can also cause serious injuries to personnel.

Prior to starting cleaning efforts on routine stains such as rusting from nearby metals or efflorescence, the cause of the stain should be identified and remedied if possible so that further cleaning efforts are avoided. Cleaning procedures should be started in small inconspicuous areas to ensure the cleaning method is effective, non-damaging, and provides the desired results. Once the effectiveness of the cleaning method is determined it can then be applied to the entire building.

Substrates

The ease of cleaning a masonry wall can be affected by the mortar used in the wall. Cleaning products and techniques applicable to one masonry wall may not be appropriate for others. In addition, special consideration should be given to walls incorporating more than one material, such as a concrete masonry wall with clay masonry banding.

Concrete Masonry Units

Concrete masonry products may have a relatively smooth surface, formed from a thin layer of cement paste resulting from the typical concrete masonry manufacturing process. Aggressive cleaning methods may remove this layer, exposing aggregate and altering the final appearance.

Other concrete masonry products may have a bush hammer, chiselled or bold texture produced during manufacturing. The textured face tends to hide minor soiling and makes these units more forgiving of minor efflorescence or other discolourations. This texture is also more suited to cleaning solutions if that technique is required.

Mortar

Choosing a mortar colour close to that of the concrete masonry unit makes cleaning the wall of mortar smears easier, as the mortar tends to blend in. Mortar colour should be chosen to match the unit colour when smooth or ground faced units are used, as they can be difficult to clean without altering the appearance. Walls with contrasting mortar and masonry unit colours may require more cleaning to remove visible mortar.

In general, the lowest-strength mortar that will meet project requirements should be specified. Higher cement content mortars with higher compressive strengths should not be assumed to have better field performance, in fact the opposite is more often true. Mortars with lower compressive strengths tend to be easier to clean off the face of the wall than stronger mortars. Lower strength mortars also exhibit better workability, which tends to increase the quality of construction. Note that building codes may restrict the use of some mortars for particular applications. More detailed information on masonry mortars is available in TEK 9-1A, Mortars for Masonry Construction (see *References*).

Cleaning Concrete Masonry TEK 08-02A and TEK 08-04A - cont'd

Cleaning During Construction

Many stains can be prevented or minimized through proper design, construction, and maintenance procedures. Construction practises can greatly impact the amount of cleaning required for a newly constructed wall. For example, proper grouting procedures can help prevent grout blowouts and the associated clean up. Keeping the masonry as clean and dry as possible during construction can allow for easier cleaning when construction is complete.

Cleaning exposed concrete masonry during construction encompasses such issues as the control of efflorescence and of mortar and grout droppings and smears. Detailed information on construction practises that minimize efflorescence are discussed in *Control and Removal of Efflorescence, TEK 8-3A*.

The following are recommended practices for minimizing mortar and grout stains during construction:

> Mortar squeezed out of mortar joints as units are placed should be cut off with the edge of the trowel, and care should be taken that the mortar doesn't fall onto the wall surface or smear the surface as it falls off.

> When mortar does land on or smear the surface of the concrete masonry unit, it should be removed after initial set. Walls should be cut and brushed clean before scaffolding is raised.

> Mortar droppings which adhere to the exposed face of the units can be removed with a trowel or chisel after being allowed to harden. Any remaining mortar can then be removed with a stiff fibre or bristle brush.

> Excess mortar should be periodically removed from scaffolding.

> Grout spills should be immediately removed by washing and brushing.

> The base of the wall should be protected from splashing mud and mortar and grout droppings by spreading plastic sheets 3 to 4 ft (914 to 1,219 mm) on the ground adjacent to the wall and 2 to 3 ft (609 to 914 mm) up the face of the wall.

The base of the wall should be protected from splashing mud and mortar droppings by spreading plastic sheets 3 to 4 feet on the ground and 2 to 3 feet up the wall. Covering the tops of unfinished walls at the end of the workday prevents rain from entering the wall and thus reduces the chance of efflorescence forming on the wall. Covers should be draped at least two feet down each side of the wall and a method provided to hold them in place.

In addition to these recommendations, newly constructed masonry should be protected when adjacent construction procedures may splatter or otherwise stain the masonry. For example, plastic should be placed over masonry when concrete is poured nearby and when curing agent is sprayed.

Cleaning Concrete Masonry TEK 08-02A and TEK 08-04A - cont'd

Planning the Cleaning Procedure

The cleaning agent and procedure should be carefully planned, based on the type of contaminant and desired results. The cleaning method chosen should be the gentlest method that will effectively clean the wall. Before cleaning, ensure that mortar joints are cured, so the cleaning does not damage them.

No attempt should be made to remove a stain until it is identified, and its removal agent determined. If the staining substance cannot be identified, it is necessary to experiment with different methods on an inconspicuous area. The indiscriminate use of an inappropriate product or the improper application of a product may result in spreading the stain over a larger area or in causing a more unsightly, difficult to remove stain.

Cleaning methods may alter the appearance of the finished masonry; typically, at least some cement paste is removed from the surface of the units. When this happens, more aggregate is exposed to view, which can alter the colour. In general, the more intense the cleaning method, the more paste is removed and the greater the potential for altering the wall's appearance. For example, sandblasting can be expected to alter the appearance to a greater degree than cleaning by hand with detergent and water. Note also that the same cleaning method may have different results based on the specific procedures used. Sandblasting at a lighter pressure will produce different results from sandblasting at a higher pressure. Again, the mildest cleaning method that will satisfy should be chosen.

The cleaning agent and procedures should first be used on a sample panel or inconspicuous location to assess: their effectiveness for the type of contaminant being removed; their effect, if any, on the finished masonry appearance; as well as the agreed upon the level of cleanliness. After cleaning, the sample panel should be viewed from 20 ft (6,096 mm) under diffused lighting to evaluate the results.

Many chemicals can be applied to concrete masonry without appreciable injury to the surface, but strong acids or chemicals with a strong acid reaction should be avoided. Even weak acids should be used only as a last resort as they dissolve the cement matrix of the masonry beginning at the surface. This leaves the face more porous so that it absorbs more water and exposes more aggregate thereby changing the colour and texture of the masonry.

Removing stains from concrete masonry can sometimes leave the treated area lighter in colour than the surrounding area because surface dirt has been removed along with the stain or the surface has become slightly bleached. This is particularly true for buildings that are several years old. This may necessitate treating the entire wall. Whichever cleaning method is chosen, it is important that all the masonry be cleaned in the exact same manner (including dilution rate, brushing/scraping method, dwell time, reapplication, rinse procedures, etc.) to maintain a uniform appearance. Similarly, care should be taken to avoid overlapping of areas being cleaned, as this may also lead to a nonuniform appearance.

Materials such as glass, metal, wood, concrete architectural or concrete masonry and any landscaping adjacent to the area to be cleaned should be adequately protected, since they may be damaged by contact with some stain removers or by physical cleaning methods. The level of protection and area requiring protection vary with the cleaning method, so the cleaning agent manufacturer's recommendations should be followed.

Cleaning Concrete Masonry TEK 08-02A and TEK 08-04A - cont'd

Cleaning Methods

The methods of cleaning concrete masonry can generally be divided into four categories: hand cleaning, water cleaning, abrasive cleaning, and chemical cleaning. Cleaning by any method should be performed on an inconspicuous section of the building or a sample panel to ascertain its effect.

Hand Cleaning

Simple hand tools such as a trowel, chisel, stiff bristle or fibre brush, abrasive block or broken pieces of masonry are first used for cleaning during construction. Steel-wire brushes should not be used because they can leave behind metal particles that may rust and stain the masonry.

Water Cleaning

Water cleaning involves scrubbing with water and detergent, water soaking, steam cleaning or pressure washing. Water cleaning is the recommended method by Permacon. When using water cleaning methods, the amount of water used should be limited to the least amount that will effectively clean the wall, as any water that enters the wall may promote efflorescence. See Control and Removal of Efflorescence, TEK 8-3A, for more detail.

Unpainted walls can usually be cleaned by scrubbing with water and a small amount of detergent. This is a nonaggressive cleaning method that generally does not alter the masonry appearance. It may not be cost-effective for large areas, however, due to the labour involved.

Brushes: Clay or dirt should first be removed with a dry brush. Steel-wire brushes should not be used because any metal particles left on the masonry surface may rust and stain the masonry. Nonmetal brushes such as stiff fibre or nylon are preferred.

Soaking: Soaking with water causes dirt deposits to swell, loosening their grip on the underlying masonry and allowing them to be flushed away with water. Again, this method may not be appropriate if efflorescence is the primary concern. More extensive efflorescence may require more extensive cleaning.

Temperature: Heated water is useful on greasy surfaces or during cold weather. However, when used with alkaline chemicals, warm water should not exceed 160° F (71° C). There is no significant advantage to using hot water with acid cleaners.

Pressure Washing: Pressure washing equipment can be effective for surface cleaning and is often specified for masonry restoration work to avoid the use of harsh chemicals. However, when improperly applied, it can cause severe damage.

If pressure application of chemical cleaning agents is considered, the surfaces to be cleaned must be thoroughly prewetted, cleansing agents must be prediluted, and the application pressures should be kept to a minimum.

Water pressure should be kept to a minimum to avoid driving water into the wall which can cause efflorescence. Note that high pressures can damage masonry or alter the final appearance. Using consistent pressure and maintaining a set distance from the wall will produce the most uniform results. If high pressure cleaning is used, it is recommended that:

> the pressure be limited to 400 to 600 psi (2.76 – 4.14 MPa)

> a wide flange tip be used, never a pointed tip

> the tip be kept at least 12 in. (305 mm) from the masonry surface

> the spray be directed at a 45° angle to the wall (never perpendicular to the wall). Pressure washing can also be used as an adjunct to scrubbing. The mild agitation created by brush application improves the overall cleaning results and enables the rinsing pressure to be kept to a minimum

High-pressure washing, however, should not be mistaken as a total replacement for hand labour. The mild agitation created by brush application improves the overall cleaning results while enabling rinsing pressure to be kept to a minimum.

Cleaning Concrete Masonry TEK 08-02A and TEK 08-04A - cont'd

Chemical Cleaning

Many proprietary cleansing agents are available for concrete masonry – see the list below of available cleaning solutions for more information. Premixed chemicals eliminate many potential problems, such as those associated with mixing reactive chemicals. They are also mixed in the proper proportions to be safely used on masonry. Strict adherence to the manufacturer's directions is required, to protect both the user and the masonry, and to avoid any potentially harmful runoff.

For the most part, products suitable for concrete are suitable for concrete masonry and can be found at many Permacon Masonry Distributors locations.

Brand: **EaCo CHem**
Product: **NMD 80**
eacochem.com/eaco_product/nmd-80

Brand: **Prosoco**
Product: **Prosoco 600**
prosoco.com/product/600

Brand: **Prosoco**
Product: **Prosoco Vana Trol**
prosoco.com/product/vana-trol

When used in conjunction with water washing techniques, chemical surfactants help dissolve contaminants and allow them to be washed away during the final rinsing process. If chemical cleaning agents are used, the surfaces to be cleaned must be thoroughly prewetted with low water pressure (maximum 30 to 50 psi, 207 to 345 kPa), cleansing agents must be diluted as directed by the manufacturer and the application pressures should be kept to a minimum. After the application of the cleansing agent, the wall should be thoroughly rinsed with fresh water (preferably at low pressure), or if necessary, at high pressure using the precautions discussed in the Water Cleaning section.

Chemical cleaning can be a more aggressive method than pressure washing. With proper technique, the results are uniform across the wall, although the wall's final appearance can be changed by using this method. Apply chemical cleaning solutions with low pressure spray (less than 50 psi, 345 kPa) or soft-fibered brushes.

Chemical cleaning solutions can be used to clean concrete masonry without damaging the surface; avoid using raw or undiluted solutions. Even diluted solutions should be used with caution, and only after thoroughly prewetting the wall, as cleaning solutions dissolve the cement matrix at the masonry surface and can also damage any integral water repellent at the surface. This leaves the face more porous and exposes more aggregate, thereby changing the colour and texture of the masonry. Cleaning agents should never be applied under pressure. As a guideline, any cleaner with a pH below 4 or 5 should be considered acidic in nature. In addition, highly alkaline products require an acidic neutralizing after wash as well as thorough rinsing; efflorescence can be an unwanted result if there is a residual alkali.

Control and Removal of Efflorescence
TEK 08-03A

Efflorescence is a deposit of soluble salts and bases, usually white in colour, that sometimes appear on the surfaces of masonry or concrete construction. Although it may be an aesthetic concern, efflorescence will not affect structural performance.

Often efflorescence is apparent just after the structure is completed. If the efflorescence is essentially uniform throughout the exterior facade, it indicates normal water loss from the materials and the building. Some identify this occurrence as "early age" efflorescence or "new building bloom". If unattended, the salt will eventually be removed by rain water.

If the deposit is heavy and essentially shows as white streaks immediately below mortar joints or covering localized areas of the masonry, it indicates that water has entered or is entering the wall at a higher elevation. These salts are called leachates, referred to "lime spots", "lime runs" and "lime deposits"; and are sometimes identified as "late age" or recurrent efflorescence.

This section discusses the various mechanisms which cause efflorescence and presents recommendations for its control and removal.

Causes of Efflorescence

A combination of circumstances causes efflorescence. First, there must be soluble compounds in the masonry. Second, moisture must be present to pick up the soluble salts and carry them to the surface. Third, some force—evaporation or hydrostatic pressure—must cause the solution to move. If any one of these conditions is eliminated, efflorescence will not occur.

Sources of Salts

The individual elements and compounds associated with efflorescence may be present in concrete masonry units, mortar, and grout. However, the efflorescence of masonry is generally attributed to water soluble sodium, potassium and calcium. These solutions either precipitate as hydroxides or combine with atmospheric carbon dioxide and sulfur trioxide. The compounds produced by the combination of these elements are white or yellow salts, all of which are less water soluble than their former hydroxide counterparts. Chlorides are usually a result of contamination of masonry units and sand by sea water or runoff from alkaline soils. Since chloride salts are highly soluble in water, rain will often wash them off.

The amount and character of the deposits vary according to the nature of the soluble materials and the atmospheric conditions. Efflorescence is particularly affected by temperature, humidity, and wind. In the summer, even after long rainy periods, moisture evaporates so quickly that comparatively small amounts of efflorescence are brought to the surface. Thus, efflorescence is more common in the winter when a slower rate of evaporation allows migration of salts to the surface. In spring, condensation frozen within the masonry may be released by warm weather allowing for further solubilizing of compounds and their migration to the surface. With the passage of time, efflorescence becomes lighter and less extensive unless an external source of salts or recurrent water migration is present.

In most cases, compounds that cause efflorescence are water soluble and are left on the surface as the water containing them evaporates. Sometimes, however, chemicals in the construction materials react with chemicals in the atmosphere to form the efflorescence. In the case of concrete masonry or mortar, the hydrated cement contains some calcium hydroxide (soluble) as a product of the reaction between cement or lime and water. When this calcium hydroxide is brought to the surface by water, it combines with carbon dioxide in the air to form calcium carbonate (slightly soluble), which then appears as a whitish deposit.

Control and Removal of Efflorescence TEK 08-03A - cont'd

Cement used in the production of mortar and concrete masonry units contain small amounts of water-soluble compounds of sodium and potassium. Such water-soluble alkalis, present as only a few tenths of one percent, can appear as efflorescence when leached out of the masonry by migrating moisture and concentrated at some point on the surface.

In addition to the masonry materials, building trim such as concrete copings, sills and lintels may also contain considerable amounts of soluble compounds. Some admixtures or ground water may also contribute to efflorescence. Most admixtures are proprietary, and their compositions are not disclosed. Accordingly, the efflorescence potential of such admixtures should be determined by experience or laboratory tests. Dispersing agents used in pigments may increase the potential for efflorescence.

Sources of Moisture

Water serves as the vehicle by which soluble salts and bases are transported to the surface, where they accumulate as the water evaporates. The primary source of moisture is rainwater. Rainwater may enter the wall through one or more of the following paths—permeable masonry units, partially filled mortar joints, inadequate flashing and sealing details, and cracks or other openings in the wall.

Considerable moisture may also enter a masonry wall as vapour from the interior of a building and accumulate within the wall as it condenses. Excessive accumulation of condensed water vapour may lead to efflorescence.

A third source of moisture that may contribute to the future formation of efflorescence is water that enters the masonry during construction. Improper protection of masonry during and after construction can allow considerable moisture to enter, which can cause efflorescence.

Masonry in contact with soil, such as in basement and retaining walls, may absorb ground water containing soluble salts. Through capillary action, salts present in the soil may rise several feet above the ground, producing an accumulation of salts in the masonry.

Control and Efflorescence

Since many factors influence the formation of efflorescence, it is difficult to predict if and when it will appear. However, to reduce the probability of efflorescence occurring in masonry construction, it is necessary to minimize the number of soluble salts and moisture present in the masonry. Of the two, moisture is the more easily avoided, as explained in the following sections.

Design

The reduction of moisture in concrete masonry will minimize the mechanisms that cause efflorescence. The designer must review each area of the design prior to construction to see if water can enter and where it will flow or accumulate if it does enter.

The selection of the wall type—single-wythe, multi-wythe or cavity—should be considered from the standpoint of resistance to rain penetration and the exposures to which it may be subjected. Design details that will prevent the entrance of moisture into the masonry assembly are critical. Details that will direct water collection away from wall tops and horizontal surfaces should be considered. If architecturally feasible, wide overhanging roofs help protect walls from rainfall.

Parapets require special attention because of their exposure. Flashing should be installed in locations where water will tend to accumulate (i.e., parapets, spandrels, lintels, base of the wall) within the masonry. The flashing should be installed to direct the water outward through weep holes.

Joints between masonry and door and window openings should be given careful attention during design as well as construction. Backer rods and sealants should be properly selected and installed in the same careful manner as other elements in the structure. TEK 19-2B Design for Dry Single-Wythe Concrete Masonry Walls and TEK 19-4A Flashing Strategies for Concrete Masonry Walls (see References) provide a more complete discussion on the proper use of flashings and details to minimize water entry.

Construction

Materials received at the construction project should be properly stored throughout the construction process. Units should be stored on pallets, or otherwise isolated from the ground, and be adequately covered to prevent water absorption.

Materials removed from stockpiles should be handled such that they remain protected from rain and soil. The distribution from the stockpile should be such that the colour range of the units is known and units with acceptable colour variations is uniformly dispersed throughout the field of the masonry.

During construction, the mixer, mortar box and mortar boards should be kept clean. During cold weather construction, this equipment should not be de-iced with salt or antifreeze material. Tools should also be clean and free of rust, salts and other harmful material. For example, workers should not use a shovel for salt and then use it for sand without first thoroughly washing the shovel.

Inadequate hydration of cementitious materials caused by cold temperatures, premature drying or improper use of admixtures should be prevented.

At the end of the workday and after completing one segment of masonry, the top surface of the masonry should be protected to prevent water penetration. Uncovered masonry walls are vulnerable to large quantities of water entering the wall.

Close cooperation between the masonry contractor and designer is necessary to ensure good design and detailing are correctly carried out through the construction. Workmanship greatly influences the

Control and Removal of Efflorescence TEK 08-03A - cont'd

weather tightness of concrete masonry walls. Concave or vee-shaped mortar joints should be used where the masonry will be subjected to rain or freeze-thaw exposure. Tooling of the joints should be delayed until the mortar is "thumbprint hard". This partial setting of the mortar provides resistance to the tooling action and forces the mortar tightly against the face shell of the unit to form a good weather-tight seal. Joints that do not provide compression of the mortar during the tooling process such as raked, flush, and cut joints are not recommended for exterior applications. They not only do not provide the necessary compressing action against the unit, but by their very nature, leave a ledge for water to accumulate and slowly soak into the masonry.

Head joints are more vulnerable to leakage and poor workmanship as the force of gravity is not working to compress the mortar against the unit to provide a good seal. Head joints must be properly filled to the full thickness of the face shell and compacted by shoving the unit being placed against the previously laid unit. Then, of course, the joint must be properly tooled.

The use of water to remove surface accumulations, including efflorescence, will cause additional water to enter the wall particularly if it is applied under high pressure. This water may promote further efflorescence.

Removal

Before any effort to remove the efflorescence is undertaken, the reason for the efflorescence should be established. If it is "early age efflorescence," moist construction materials may be the cause. If "late age efflorescence" is observed, the possibility of water leakage should be investigated. If the efflorescence is near ground level, ground water may be the cause. Generally, if efflorescence is the main concern regarding masonry surface discolouration, the masonry walls should be allowed to cure and then the salts should be removed.

Compared to other stains, the removal of most types of efflorescence is relatively easy. As stated previously, most efflorescing salts are water soluble, and many will disappear with normal weathering unless there is some external source of salts.

Please see the list of recommended cleaning solutions below and follow the the cleaners manufacturer's guidelines for best results. Windows, doors, or surrounding materials may need to be protected during the application.

Brand: **EaCo CHem**
Product: **NMD 80**
eacochem.com/eaco_product/nmd-80

Brand: **Prosoco**
Product: **Prosoco 600**
prosoco.com/product/600

Brand: **Prosoco**
Product: **Prosoco Vana Trol**
prosoco.com/product/vana-trol

Cracking
TEK 08-01A

Causes

Once placed in a structure, concrete masonry units are subject to a variety of forces and stresses which, besides structural loads, include shrinkage stresses due to drying, temperature fluctuations, and carbonation (an irreversible reaction with carbon dioxide in the atmosphere). Although the net resulting shrinkage in a finished structure can vary considerably (for example, temperature movements can vary greatly with exposure and unit colour, while drying shrinkage can be expected to be higher for units having a higher cement content), the combined effect of these shrinkage components could be sufficient to cause large tensile cracks in the masonry if proper precautions are not taken. Shrinkage cracking and crack control strategies are covered in more detail in other sections of our maintenance guidelines.

The next leading cause of cracking in concrete masonry walls is differential settlement due to uneven support of the foundation. Due to the highly complicated and problematic nature of such cracks, it is encouraged to seek the aid of a qualified design professional for recommendations on corrective actions for differential settlement.

Any objectionable crack should be analyzed to determine the cause and any previous corrective measures taken to prevent or accommodate the movement before additional repairs are made. If not, cracks may simply form again. Since the necessary corrective action required in crack repair is highly dependent on the cause of the crack and whether the crack is stable (the crack has stopped getting wider), significant attention should be focused on these issues. A simple straight forward method of determining if a hairline crack is continuing to propagate or widen is to patch over a small length of the crack with gypsum plaster and monitor the patch regularly for several days. Additionally, a variety of gauges can also be used to routinely monitor crack widths. The benefit associated with implementing crack width and/or deflection measuring gauges is that qualitative data is obtained which can be used to determine an appropriate crack repair method.

Solutions

Control joints

Control joints are used to relieve horizontal tensile stresses due to shrinkage by reducing restraint and permitting movement to take place. They are placed in concrete masonry walls to prevent cracking. Vertical separations are built into the wall at locations where stress concentrations may occur.

To resist moisture penetration, control joints are filled with backer rods and sealants, or with other approved materials. These materials should be inspected periodically for any damage or foreign debris, and to ensure the sealant has not torn or debonded from the masonry wall. Damaged sealants should be removed, and new sealants should be installed. Prior to filling the joint, the edges of the masonry in the joint may need to be cleaned and primed to ensure the sealant will adhere to the masonry.

If it is determined that cracking is present due to the lack of, or inadequate spacing of control joints, it may be necessary to retrofit the structure with control joints. Installation of control joints in an existing structure is completed by first determining the location and spacing of required control joints by an approved method. Next, a vertical joint is saw-cut at the location of a head joint through the mortar and masonry units. The joint should extend completely through the wall and be approximately 3/8 in. (10 mm) wide, or one mortar joint wide. Finally, the newly cut joint should be cleaned, filled with a backer rod and caulked. The sealant will prevent water, dirt, or insects from entering the structure. Before retrofitting any building with control joints, consult a qualified design professional.

Cracking TEK 08-01A - cont'd

Tuckpointing

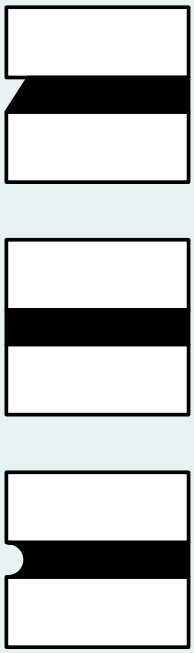
If the cracking is not extensive, confined primarily to the mortar joints, and relatively stable in width, it can be readily repaired by conventional tuckpointing (also called repointing) methods as detailed. Unless the wall is to be parged or coated, efforts should be made to match the colour and texture of the new joints to the old. If the identity of the original mortar materials is unknown, trial batches of different mix designs should be applied in test joints, tooled, and aged for a period of at least one week. Variations in the age of the mortar when the tooling is performed as well as the tooling pressure are suggested as well since both affect colour and texture. The best match can then be selected. It should be noted that because of dirt deposits and stains, matching existing mortar colour of old buildings may be difficult. Accordingly, cleaning of the masonry may be required prior to applying tuckpointing efforts.

Water repellents coatings

Small cracks that do not pose a structural problem may be susceptible to water penetration due to wind-driven rain. A variety of coatings are available that can effectively resist water penetration. Note, however, that cracks larger than 0.02 in. (0.5 mm) cannot usually be sealed with clear water repellents.

Tuckpointing Tips

1. Remove old mortar. Cut out the old mortar being careful not to damage the nearby units or to remove too much mortar at one time. Generally, the depth of cut should not exceed 3/4 inch, or until sound mortar is reached.
2. Select the proper mortar type. As much as possible, try to closely match the mortar used in the original construction. In general, softer mortars with more lime than typical mortars serve as a more effective tuckpointing mortar.
3. Pre-hydrate the mortar. Mix the mortar using as little water as possible and allow the mix to hydrate for one to two hours prior to repointing. Using a stiff mortar will reduce the plastic shrinkage.
4. Place new mortar. Force new mortar into the joint in layers not exceeding 1/4 inch (6 mm). Each layer should be thumprint hard before subsequent layers are applied.
5. Finish tooling. Once the mortar has sufficiently set, tool the mortar to match the original mortar.



Unit Degradation
TEK 08-01A

Causes

Spalling and popouts in concrete masonry units are uncommon. However, under certain conditions they can occur, and units can also be damaged from large impacts. Such units should be inspected and repaired in a timely manner. Where the cause of the degradation is not apparent, consideration as to the cause of the defect should be given along with consideration of whether future degradation may occur. Obviously, if future degradation is expected, the cause should be remedied prior to making repairs. Causes of continuing damage include water penetration that may lead to freeze-thaw damage, excessive salts and chemicals from weed killers and fertilizers, and ivy and other plants.

Solutions

Replacement unit

Damaged or cracked units can be patched with mortar materials, depending on aesthetic concerns. Replacing a damaged unit can be accomplished by carefully chiselling or sawing out the broken unit and all the surrounding mortar. Once all the old mortar, dust, and debris are removed, a replacement unit can be installed by buttering the edges of the unit with mortar and placing it in the opening in the wall. The mortar should be tooled to match the original profile once the mortar becomes thumbprint hard. If the unit that requires replacement contains vertical reinforcement or is grouted, only the face shell of the unit may be able to be replaced. In this case it is advisable to spread mortar on the back of the face shell as well to provide bond between the grout as well as to the surrounding masonry units.

Owner Responsibility
TEK 08-01A

Because masonry has earned the reputation as a long-lasting and durable material, owners may not factor into their annual budget funds needed for maintenance of masonry walls. While these walls typically need much less attention than other materials, the cost invested by the owner in regular masonry maintenance throughout the life of the structure will pay great dividends in the long run.

Owner's Manual

A successful maintenance program begins with a good owner's manual. This manual should identify and describe all the materials and equipment installed in the building and should outline the maintenance needed for each of these items. The manual also should include updated as-built project drawings and details rather than initial design and bid specifications. The material and equipment descriptions should include the product name, the manufacturer, the expected life cycle, associated material safety issues, and where to turn for more information.

The owner's representative, typically the architect, should assume responsibility of compiling the owner's manual. To ensure completion of the manual, it should be included as part of the scope of work when the job is put out to bid. Records of inspections and corrective measures conducted should be assembled and kept up by the building maintenance personnel as a supplement to the manual.

Inspections

The owner's manual should stress the need for periodic condition assessments. Timely identification of problems or even potential problems can greatly reduce the costs associated with corrective measures. While most of the inspection can be done by visual assessment of the exterior surface of the masonry, the condition of the interior of the structure can also be useful to determine the performance of the masonry in areas such as water and air penetration resistance. Building maintenance personnel or other owner's representatives should perform these inspections at least annually. Masonry or building specialists should be consulted for a more thorough inspection every five years.

Conclusion
TEK 08-01A

Concrete masonry products are available in a variety of finished faces. Contaminants from construction, such as mortar smears, and from the atmosphere after years of exposure can mar the otherwise attractive appearance of concrete masonry buildings. Cleaning methods that have been effective include hand cleaning and the use of water and chemical solutions.

Below is a list of items made to schedule regular replacement of materials that are known to have a typical effective life that is less than that of the masonry. Examples of these materials and their common performance duration are listed next.

Maintenance Schedule	
Building Element	**Frequency**
Exterior	
Check the overall appearance of the structure for any signs or damage of misfunction to the exterior.	Periodically
Inspect mortar and units. Ensure intimate contact between mortar and units. Check for the presence of cracks, chips and other surface degradation.	Annually
Check plumb and vertical alignment of wall surfaces.	Every 2 to 5 years
Check for the pressence of dirt, stains, efflorescence and graffiti and clean as necessary.	Annually
Examine flashing and weep holes to ensure proper function. Repair screens as necessary.	Bi-annually
Examine the condition of sealants at the control joints.	Annually
Examine the condition of the caulking materials.	Annually
Check for locations and sources of moisture.	Annually (Spring)
Check for ivy and its effects on the masonry.	Annually (Spring)
Examine the condition of coatings.	Annually
Examine the condition of the parapet cap and copings.	Annually
Examine the condition of the roof membrane.	Annually
Check the condition of the roof drains, gutters, downspouts, and splash blocks. Clean and repair as necessary.	Spring and Fall
Check to make sure that the ground slopes away from the building on all sides.	Annually (Spring)
Check the size of trees and shrubs near the building.	Annually
Check for the pressence of insects and vermin. Remove nests and clean weep holes as necessary.	Annually
Verify adequate anchorage and performance of sign, porch lights, etc. attached to the exterior.	Annually
Interior	
Inspect for signs of water leakage and mold growth.	Bi-annually
Check plumb and vertical alignment of wall surfaces.	Annually
Examine the condition of the sump pump and french drain.	Annually
Windows and Doors	
Examine flashing and repair as necessary.	Bi-annually
Examine caulking or weather stripping and replace as necessary.	Bi-annually
Concrete Masonry a Feel for drafts and look for signs of possible water entering the structure.	Bi-annually
Fireplace	
Examine chimney for loose masonry units or mortar.	Annually
Have chimney flue inspected and cleaned.	As needed

Estimated Life of Materials	
Material	**Estimated life (years)**
Concrete Masonry Units	100+
Caulking	5 - 15
Coping/Flashing	25+
Mortar	100+
Paint	5 - 10
Post-applied water repellent	5 - 10
Stucco on masonry	100+

References

www.masonryandhardscapes.org/technical-resources/resource-search/

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