HISTORIC BRICKWORK

Fine Print: The information below is not a research paper and no references are provided'; it is a compendium of material gathered during my years of practice. The information provided is generally correct, and the reader is invited to research the contents for verification. Any comments or criticisms are invited.

Background

Historic brickwork falls under the major heading of Historic Masonry, which includes Stonework, Terra-cotta, Tiles and Mortars.

Brickwork has been a building material for thousands of years. The earliest recorded use of brick as a construction material dates back to the seventh millennium, BC for unfired brick and the third millennium, BC for fired brick. The early Romans introduced it to Europe. In Canada, the earliest recorded use of brick dates back to Champlain's Port Royal settlement of 1605. Locally manufactured bricks were used in the early settlements for the construction of fireplaces and chimneys.

Because of differences in materials and methods of construction, a restoration project containing historic brickwork requires a thorough understanding of the materials of construction as well as the science of building envelopes. The following is a brief dialog on some of the major issues.

Bricks

Period bricks were manufactured by heating mineral clays to produce a hard weather resistant material to be used for construction. The heating, or firing process, occurred in a large oven called a brick kiln. Firing transformed the clay by fusing the clay particles into a 'glass-like' mass. This process was called vitrification. Because of the type of kilns used and the lower heat produced by early kilns, the heat required to vitrify the surface did not always reach the inner part of the brick. This resulted in a brick that had a vitrified outer skin and a softer inner core.

Early kilns were wood fired and produced a variety of end products, often from the same load of bricks being fired. Historic bricks, in general, have three distinct zones of hardness within their cross-section, the softer 'core' material, a harder 'transition zone' and the exterior surface. The outer surface, invariably, was the hardest part or most vitrified and is referred to as the 'fireskin'. Because bricks were located in different areas of the kiln when they were fired, these zones of hardness varied with each batch.

Because clay materials from a single pit could have a variety of minerals present in different areas of the pit, bricks from the same pit could have different properties and may be different in colour. The surficial clays, being more weathered and oxidized than the deeper clays in a pit, generally produced lighter coloured bricks. If the history of brick production from a single pit is known, it is possible to estimate the approximate period during which the bricks were produced.

Replacement bricks, preferably, should be sourced from the building being restored. Alternately, if masonry units are required and cannot be recovered or sourced from the restored building, extreme care should be undertaken in selecting the new supply.

Calcareous and Non-Calcareous Bricks

Durability of historic bricks is dependent on many factors. There are, in general, two distinctive types of historic bricks based on their chemical 'makeup'. Bricks are classified as calcareous and non-calcareous. Calcareous bricks are often yellow coloured, containing calcium silicates. Non-calcareous bricks are often red coloured containing iron and silicates. Both are suitable for construction purposes. The differences in the types of classification is determined by the degree of vitrification, the porosity and the pore size distribution.

Calcareous bricks tend to be a fired at a lower temperature to achieve vitrification. This has the effect of creating smaller pore sizes which reduces the freeze-thaw durability. Bricks fired at a lower temperature tend to be more susceptible to deterioration from expansion products of their constituent chemical makeup. At low firing temperatures, calcareous bricks have a greater degree of vitrification and compressive strength. Firing temperatures are typically in the order of 700°C to 800°C.

Non-calcareous bricks are generally fired at a higher temperature and tend to be more durable and have a higher freeze-thaw resistance, to deterioration, due to a greater distribution of larger pore sizes. To achieve a similar strength and resistance, calcareous bricks must be fired at a temperature exceeding that of the non-calcareous variety. Firing temperatures tend to be in the order of 1000°C, and higher.

Due to differences in the brick material for wetting and durability, replacement of historic masonry units should attempt to match the original brickwork material. Replacement bricks in a wetted condition should appear to be similar to the surrounding masonry.

Composition of Historic Bricks

To improve the physical properties of bricks, the brick clays were blended with other materials. Silica, in the form of sand, was added to reduce the plasticity, adsorptivity and the shrinkage. Ground portions of bricks from earlier firings were sometimes added to improve the physical properties of the clay. The added ground or crushed brick material was called 'grog'. To promote the vitrification of the clay and sand, fluxes were added to lower the temperature required to provide a harder, more durable, brick. Early brick makers also learned that the colour of the finished brick could be changed by adding other minerals to the clay.

The earliest bricks were shaped by hand packing them into wooden brick molds. These molds would hold only one or two bricks. As demand increased, this method was supplanted by the use of horses and metal molds and a dozen or more bricks could molded at one time. To keep up with demand, starting about the middle of the 19th century, bricks were producing from an extruded pug. A rotating wire was used to cut them to length. This is similar to the method used today.

Because of the variability in the physical properties of the finished brick, after being fired and cooled, historic bricks were hand selected for suitability. Some bricks were underfired and were not as durable and others might be overtired or over vitrified and might be distorted. These were discarded or crushed to make 'grog*. Others bricks may have been too underfired to use in exposed areas might still be useable for interior wythes of exterior walls or for interior partitions, etc. where they did not have to withstand the effects of weather. It is this hand selection process that further complicates the use of bricks from other sources; care must be taken to make sure the bricks have similar physical and chemical properties to those they are replacing, and that they are suitable for the type of exposure intended.

Historic brick is often not of a uniform size. In spite of legal standards developed in the late 18th century to establish uniform brick sizes, there is a considerable variety in the physical dimensions found in historic brickwork. Bricks might have a stretcher face dimension (length) of *&V2"* to 9° and have a header face dimension (width) of between 4" and 4Vi. The height of the brick may vary from *2Vi* to 3".

In addition to the 'standard' brick sizes, special molded bricks for the construction of brick arches and other decorative effects were also produced. Some brick manufactures also produced oversized softer bricks that could be 'rubbed down' to produce special shapes.

Bricks used for restoration should have similar physical and chemical properties as those being replaced. This is often overlooked in restoration work. One of the problems of restoration of brick masonry is that the selection of the brick being replaced is based only on the colour, texture or size.

Historic Mortar

Mortar and Mortar Joints

The use of mortar in historic brickwork is almost a study unto itself. It is a complex subject and one that is essential for the longevity of the finished brickwork. Historically, proper mortars were the art of the mason and lacked a formal specification.

When a formal specification was available, they were often obscure. The mortar for the Parliamentary Library Building in Ottawa, for example, was specified in two parts. The first part of the specification was for the mortar used for the general bedding of the masonry and the second part of the specification for mortar used for pointing or finishing the joint. The bedding mortar was to be batched using the "...best fresh burnt brown lime...'. It is not recorded anywhere what 'brown lime' is. In addition to the ambiguous description of the bedding mortar, the pointing mortar was to be batched using "...one part best brown lime, one part sharp forge ashes, and one part iron scales.... It can be seen from this example that batching historic mortars is not a simple matter, even when the constituents are known.

The problem is complicated because early mortars generally used lime alone as a 'plasticizing' and bonding agent for the sand. The early limes had natural impurities or pozzolans that provided them with hydraulic or semi-hydraulic properties. It was a 'spin-off of these impurities that permitted mortars to harden in a wet or damp condition and not leach out when exposed to water. That some masonry has withstood the ravages of time is often a testament to the better hydraulic properties that some of these early mortars had. Early masons had to be able to source the proper building materials to ensure a long lasting product. This was part of the skill a master of the trade developed.

Pure lime, as available today, is not suitable for mortar without the addition of a hydraulic cement. With the quality control available today, the pure limes available do not have the natural pozzolithic impurities of historic limes and must rely on the addition of Portland Cement or masonry cement to provide this property.

A mortar used for repairing or restoring historic brickwork must have several properties:

- It must be strong enough to bond the wall together and transfer the loads through the brickwork and at the same time be weaker than the bricks themselves. In this manner, repair of the wall is generally limited to repairing or replacing the mortar joints and not the bricks. This allows the mortar to 'give' and by redistribution, minimize the stresses within the brick.

- The mortar must be more permeable than the brick. This allows the bricks to breathe and prevents water from being trapped within them. Early buildings did not provide for vapour barriers and moisture within the building had to escape through the building envelope. The brickwork walls assisted in this process. Increased permeability can be obtained by using air-entrainment and by adding 'grog' to the mortar mix.

- The mortar should have a similar coefficient of thermal expansion as the brick. In addition, the shrinkage and expansion characteristics should be similar to the brick. This minimizes stresses with the wall and increases the longevity of the mortar joint.

- The mortar must be 'stiff. This also minimizes shrinkage stresses and increases the longevity of the mortar joint.

- To increase for freeze thaw resistance, the mortar should have air entrapment. In early mortars, this was achieved by mixing air into the mortar batch. Current practice is to use air entraining admixtures in conjunction with machine mixing. The mortar mixing machine should be clean of ail old mortar and the mixing blades should not be badly worn. Information from Parks Canada indicate that the air content should be in the order of 10% to 18%.

- The mortar should be lime based. The lime should be in the form of lime putty, premixed 8 or 10 days in advance of use. To obtain the necessary hydraulic characteristics, using pure lime, requires the addition of a pozzolan, generally in the form of Portland cement or masonry cement.. The pozzolan used should have a nearly white colour and should be a Type HS, Type 5, or sulphate resistant type cement. Iron is present in many bricks, and using a non-sulphate resistant cement can chemically react with the bricks to produce a ferrous sulphide which leaves a black stain on the masonry surface.

- Colour for the new mortar joints should be obtained by blending the proper coloured sands and a nearly 'neutral' coloured pozzolan. As a poor second alternative, *in lieu* of matching sand colours, the joints can be 'stained' or coloured using special proprietary methods. This is effective and relatively long lasting, but, is very labour and skill intensive. Nawkaw is one firm that provides this 'staining' process.

- The mortar joint should be tooled in a similar manner as the existing joints for both appearance as well as 'wetting' characteristics. Different joint types shed precipitation in slightly different manners, and, by replicating the mortar joints, the remediation should present a wetted surface similar to the existing. A copy of common mortar joints has been included in APPENDIX 'A'.

• Samples of the proposed replacement mortar should be provided. Two samples of each mortar used should be provided to establish a range of colours and textures; the use of a single sample is unsuitable and should not be used. It may be impossible to match the colour and texture of a single sample.

Strength is not normally an issue and a mortar with a strength of 50 to 60 psi is, generally, adequate. With stonework, the strength can be higher, but, the mortar must deform 'plastically. Plastic deformation in a solid state minimises stresses on the brickwork and allows the hardened mortar to 'flow' over time. Time being measured in decades or centuries. Any cracking normally occurs through the mortar joint and not the brick. Repair is a matter of tuck pointing the masonry joint.

Higher strength mortars, in particular using Portland Cement can adhere to the brick with sufficient strength to cause the sharp brick edges to be 'torn' free during normal thermal cycling. This causes the sharp edges to become rounded and hastens the deterioration of the brick.

If colour is an issue, a sample of the existing mortar sand can be chemically cleaned to determine the colour of the sand to be used for the new mortar. New sand of a similar colour can be sourced. The new mortar colour will be close to the original.

A typical mortar mix might be in the order of 10-12:2:1. This is the proportion of sand (10-12) to lime (2) to cement (1). The cement should be sulphate resistant Portland Cement in the event the brickwork contains iron compounds.

White Medusa cement is used to provide a better control the colour of the mortar mix, Medusa Cement reduces the dark colouring effect provided by the normal Portland cement. The above mix will have a strength of approximately 50 to 60 psi and can be adjusted to suit. A few mortar cubes can be made and tested for strength and should be similar to the hardness/strength of the wall material. If strength is required, the mix design can be modified to develop a strength of approximately 80 or 90 psi. Usually the lower limit is adequate. If the stone is relatively porous, the test cubes can be made using four CMU's placed, in a 'star' pattern to provide a 4"x4"x8" 'cube' sample. Paper towels are used for separating the cube from the CMU's. The absorption provided by the CMU's will produce a mortar strength more in keeping with the actual strength in the wall if the bricks are porous.

When restoring a masonry wall, it is essential to examine the mortar joints for soundness and ability to prevent water from penetrating the wall surface. Water can be enlikened to 'the great leveller"; it can cause a perfectly good structure to deteriorate to a 'pile of rubble' by freeze-thaw deterioration of the masonry and by brown-rot deterioration of any timber superstructure.

Bricklaying

With the exception of a single wythe wall, thickness of historic brickwork walls are generally in multiples of the width of the brick plus the thickness of the mortar joint. Although it is common to find walls 9", 13VV, or even 18" in thickness, almost any thickness can be encountered. The common term used for describing masonry wall construction made up with several thicknesses of brick is the wythe. This is defined as being the continuous vertical section of masonry wall that is one masonry unit in thickness.

To improve the strength of walls constructed of two or more wythes, the individual wythes making up the wall were connected to each other. This was accomplished by using brick stretcher courses or by using wrought iron or steel'S' hooks embedded into the mortar joints. Occasionally when working with restoration work diagonal stretcher courses are encountered. This was a method of providing a better interconnection of the masonry wythes.

When brick stretcher courses were used to connect two or more wythes together *various* coursing patterns developed. Common bonding patterns included 'English' or 'Flemish' bond where the brick courses alternated between a header course and a stretcher course, 'Liverpool' bond, where there are three stretcher courses between each header course and 'American Common' bond where four or more stretcher courses are located between each header course.

In addition to constructing brick walls as solid with multiple wythes, some brick walls were constructed using a brick inner and outer wythe connected by 'S' hooks and the space between these wythes was filled with loose brick rubble or mortar..

Single wythe brick walls were generally used as a 'veneer' over a conventional wood framed building.

Deterioration of Historic Brickwork

Deterioration is progressive. Remediation and restoration must be done in a timely fashion to prevent further deterioration. Historic brickwork can deteriorate to the point that it is no longer viable to restore it. Deterioration, in addition, often creates conditions that are dangerous to people working on the structure as well as to pedestrians or vehicles, in proximity to the structure, at ground level.

Historic brickwork generally deteriorates as a result of one of more of the following primary problems:

• Failure of the roofing, drainage or wall system has allowed water to enter the wall and consequentially, the brick has remained in a saturated state for a long period of time. This can cause a myriad of problems. If the brick was underfired it can deteriorate. If the mortar is non-hydraulic it can be leached away leaving only the sand. The bricks can deteriorate from freeze-thaw cycles. Sub-florescence or cryptoflorescence is the growth of crystals below the brick surface caused by salts within the brick or mortar. The pressure exerted by this crystal growth can cause the brick surface to exfoliate.

• The bricks were underfired and over a period of time have deteriorated due to exposure to the elements. This causes crumbling of the wall.

• Because of the loss of the durable 'fireskin', the softer less durable core is exposed to the elements. This softer material rapidly deteriorates and produces the same end result as the bricks being underfired.

• The wall is not properly drained, or the drainage has been impaired. If sufficient water is present it can freeze between the wythes and force them apart.

• Another component of the building that the brick relies on for support has failed. This can cause a small local failure or general failure of the entire wall.

• If metal ties have been used and water has been allowed to enter the wall system, these can corrode causing a local failure or general failure of the entire wall. This can be caused by the corrosion of the ties resulting in a loss of lateral support for the masonry wythes or it can be caused by the expansion products of the metal corrosion.

• Surface damage to the brickwork or deterioration of the mortars because of pollution or acid rain.

There has been a significant change in lifestyle and construction since the time of the original construction of historic brickwork. People are spending more time indoors and the lifestyle has changed significantly. One of the main effects has been a significant increase in the amount of water used. It is far easier to 'turn on a tap' than to walk to the well. In addition, for ecological and monetary reasons, doors and windows have been replaced with units that *are more* air tight. For economic reasons, the interior building environment is not being replaced with colder dryer air during the winter seasons. People are spending more time indoors during both the winter and summer seasons. One of the main effects, of these lifestyle changes, is that the humidity within a structure increases. If the added humidity is not addressed, deterioration of the historic brickwork building envelope can be accelerated.

Procedure to Examine Existing Bricks

Presenting a procedure to examine existing historic bricks is fairly straightforward. The methodology usually involves finding a highly skilled mason with experience in historic brickwork restoration and have him determine the suitability of the material. The mason usually does this by doing a visual examination. Based on years of experience, the mason can usually select quality components. The old adage, "A bad looking brick, is a bad brick", is a true statement. He looks at the definition, quality of the 'fireskin', porosity, and other characteristics to make this determination. With these skills, a substantial number of bricks can be examined in a short time. Finding a published method of examining bricks from an recognised authority was more difficult. The only published methodology, obtained, was prepared by the American General Services Administration, and is titled, *"Guidelines For Evaluating The Condition Of Brick Masonry & Mortar".* This is a recognised authority involved with providing guidelines for the restoration of American historic structures. A link to their website, at the time this paper was published, can be found at: *htto://www. gsa. gov/portal/content/l 11686*

In the event the website is not available in future, a copy of the information contained on this website has been reproduced below, with minor editing:

Guidelines For Evaluating The Condition Of Brick Masonry & Mortar

Procedure code: 421109G

Source: Developed For Hspg (Nps - Sero)

Division: Masonry

Section: Brick Unit Masonry

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Guidelines For Evaluating The Condition Of Brick Masonry & Mortar

Caution: this method of condition assessment is destructive and should only be used to test areas believed to be deteriorated. This test should be performed only by an experienced mason.

This method of evaluation was developed by restoration architect Max Ferro and masonry conservator Tom Russack and appeared in the January/February 1987 issue of the old house journal.

Materials

- Mason's hammer
- Cold chisel (1/2 to 1-1/2 inches)
- Sturdy slotted screwdriver

The deterioration of brick and mortar are evaluated by rating each on a scale from 0 to 10 based on their level hardness or softness. A rating of 0 indicates severe brick and/or mortar *deterioration.* A brief description of each rating follows.

Assessment of Brick

Rating Description

0. Bricks are totally disintegrated.

1. Evidence of spalling at least 1/4" to 3" deep.

2. Slight erosion at corners of brick; slight powdering of surface when rubbed with hand or scraped with fingernail.

3. Spalling brick in layers when rubbed with hand; fragments do not powder.

4. Bricks can be broken by poking and jabbing with screwdriver; fragments are semi-hard and resemble compacted clay.

5. FIRST CLASS OF STABLE, STRUCTURALLY SOUND BRICK: Screwdriver can penetrate the brick by hand roughly 1/4" but brick does not crumble.

6. Screwdriver can penetrate the brick roughly 1/4", but ONLY with the assistance of a hammer; this may cause coarse jagged pieces to become dislodged.

7. Screwdriver is unable to penetrate the brick even with assistance from hammer but may make a slight impression in the surface. There may be a slight ring or bounce as the screwdriver hits the surface.

8. Chisel is necessary to crack the brick.

9. Chisel is unable to make an indentation or impression in the brick; brick shears cleanly; brick is strong with crisp edges and corners.

10. A NEW BRICK: Brick with crisp corners; chisel striking the surface produces a clear ringing sound.

- A rating of '4' or below indicates brick in an unsalvageable condition.
- A rating between '5' and T indicates that some remedial measures may need to be taken.
- A rating of '10' indicates that the brick units are in good, sound condition.

Assessment of Mortar

Rating Description

No evidence of mortar within at least 1-1/2" of the wall face.

Mortar crumbles when poked with finger or screwdriver; many surface irregularities are evident.

Mortar is easily removed with screwdriver, but FEW surface irregularities are evident in joint.

Mortar collapses and freely and cleanly breaks adhesion with brick when scored along centerline with screwdriver.

Slight spalling occurs at edges and corners of brick when mortar is scored and tapped with screwdriver.

Screwdriver is unable to dislodge the mortar; chisel can disengage and pop mortar free without damaging the brick!

Edges and corners of brick are slightly marred when mortar is scored with a chisel.

Hammer AND chisel are necessary in order to disengage the mortar; there should be little damage to the brick.

Several blows with hammer and chisel are required to break the mortar into several *large* pieces; bricks will be noticeably marred.

MORTAR IS STRONGER THAN THE BRICKS: Successive blows with hammer and chisel crack brick

MORTAR HAS HIGH PORTLAND CEMENT CONTENT: Successive blows with hammer and chisel pulverizes the brickwork.

A rating between '0' and '4' indicates that repointing is necessary.

A rating between '5' and '8' indicates mortar in satisfactory condition.

A rating of '9' or '10', indicates that the mortar is too hard and should be replaced with a softer mortar.

END OF SECTION

As noted, this testing is destructive and any brick samples 'damaged' must be installed with the damaged surface on the interior of the wall and not exposed to view. It also has the caveat that this testing should only be undertaken by a skilled mason.

The work can be supervised or observed by an engineer. This may be required if parts of the work require a degree of certification for legal or contract reasons. It is not necessary to test all brick. With careful observation and examination of the material, it is possible that a representative sample be tested. This reduces the number of samples that are intentionally 'damaged'. This was the only qualitative methodology for testing brickwork and mortar joints that was located. No additional material, published by another authority, was located.

With restoration work, it is reasonable to assume that approximately 20% of the samples are not suitable for re-use. In some instances, 30% to 40% of the samples may have been damaged beyond re-use. Re-use of all brick components is very unlikely.

There are secondary problems that cause deterioration of brickwork. These are caused by a misguided attempt to fix one of the primary problems without an understanding of historic brickwork. Unfortunately, the problem may not surface for several years after the historic brickwork has been 'repaired'. Some of the secondary problems that cause deterioration of brickwork are as follows:

Earlier failures of brickwork have been restored using improper materials or methods. Often a lack of attention to the proper brick or type of mortar selected is the main cause of this type of problem.

To prevent water from entering the wall, a waterproof coating has been applied. The material selected for this may not permit the brickwork to breathe and may precipitate a failure of another kind. Some coatings do not age uniformly and may discolour the brickwork.

Inappropriate cleaning methods using chemicals may have a deleterious effect on either the masonry or mortar causing staining or deterioration of the brickwork or mortar.

Inappropriate cleaning methods using mechanical means may remove the 'hard' fireskin of the brickwork exposing the softer core which will readily deteriorate. This was a common 'cleaning' method for several historic brickwork buildings in the Toronto, Canada area.

Restoration of Historic Brickwork

Restoration can loosely be defined as maintenance and construction aimed at improving the condition and longevity of a component or assembly of components with minimal, and without significant, impact to character defining elements of a structure.

The first step in restoring historic masonry is to do a detailed study of building or area that has failed. It is necessary to obtain a thorough understanding of the building structure and envelope. It is also necessary to determine the root cause(s) of this deterioration. This investigation and all subsequent work should be well documented.

While it is generally possible to understand the cause of the failure, some causes of building failure are obscure or may be a combination of several items. Determining the cause is often a complicated and time consuming process.

It is important that the individual undertaking the restoration if aware of mechanisms 'at play' to ensure that the manner of remedy does not cause a more severe problem in the future. Extreme care should be exercised in selecting a method that will not cause future repairs and that will not prevent future repairs.

Because most deterioration of historic brick is caused by water transmission, restoration is normally a matter of eliminating the source of the problem and repairing any damage that has occurred. Because deterioration is generally a chemical process in nature, the underlying chemical processes should be understood. It is often necessary to obtain samples of the construction materials and the to be used for a chemical analysis of the components.

Also, it is often necessary to undertake a cleaning of the historic masonry surfaces. Prior to restoring the historic masonry, the surfaces should be cleaned to the desired degree to restore an appearance or an assembly resembling the original structure. This should be undertaken by a firm that specialises in restoration work.

Cleaning Historic Masonry

Cleaning historic brickwork will be outlined in a little more detail as is historic brickwork repair noted above. The reason, for the greater detail, is that these two items account for more damage to historic brickwork.

Cleaning masonry should only be undertaken when it is necessary to halt deterioration or to remove unsightly graffiti or heavy soiling caused by a 'dirty' environment. All cleaning should be undertaken in the most 'gentle' manner possible for fear of creating additional damage, both immediate and long term. Soft, natural bristle, brushes should be used for all cleaning work. Metallic brushes should not be used. Restoration must carefully balance the use of cleaning materials and the possible long term effect cleaning will have on both the brickwork and the mortar.

It must be established if cleaning is appropriate or necessary'. The source and nature of the soiling material should be examined. In addition, the method of cleaning should also address how mortar joints will also be affected. An attempt should be made to review all available cleaning records, if they can be located.

Once it has been established that cleaning is in order, the materials to be cleaned should be studied to determine the best manner to provide the extent of cleaning required. Cleaning is a difficult process at times and should not be undertaken during freezing conditions. Most cleaning procedures and commercial products have a stipulated temperature range for application.

Cleaning can be undertaken using several procedures. Initially, cleaning of a small obscured area should be undertaken as a 'test area'. It is also important that the materials of construction be clearly and correctly identified. Cleaning should commense from the bottom of the structure to the top, keeping the lower areas continuously wetted. There are numerous approaches to cleaning historic brickwork:

Water Cleaning

Low pressure warm water can be used; water is a universal solvent and can remove many materials. Water cleaning is, generally, considered to be the least aggressive cleaning by causing the least amount of damage. It should be determined that this method does not affect the mortar. Washing pressures should be established by trial, but water pressure should not exceed 100 psi. Water cleaning consists of essentially four methods. The historic brickwork can be soaked, it can be pressure washed, it can be soaked and washed using a suitable non-ionic detergent, and it can using steam and hot, pressurised, water. Non-ionic detergents are synthetic organic detergents that are not soaps and are effective for removing oil based 'dirt'. They can be removed to eliminate long term residues that may cause future problems.

Care must be taken to ensure that the water supply does not contain traces of chemicals, generally metallic ions, that can cause discolouration or staining of historic brickwork. Staining can be more pronounced on light coloured brickwork. Trace chemicals are often metallic ions dissolved in what can be potable water. It is not sufficient to specify 'potable water* for cleaning. Because the water is potable is not a guarantee that there may not be harmful dissolved chemicals that may harm historic brickwork. Often, additives can be added to the water to de-activate the metallic ions. These additives should be used with care.

Pressurised water can have a detrimental effect on mortars that are marginally hydraulic.

Acidic Chemical Cleaning

Cleaning with water can include using acidic materials. This should only be used on brickwork that is not prone to deterioration by using acidic chemicals, and, only after thorough testing. Great care and caution should be used with using acidic cleaners to prevent damage to the historic brickwork. All traces of chemical cleaners should be completely removed after cleaning has been effected. Acidic chemical cleaning often includes the use of a mild caustic based wash.

Many commercial acid based cleaners contain hydrofluoric acid. They often include phosphoric acid to remove staining caused by metallic ions, that are present after cleaning. Product information for acid based cleaners should be examined in detail and discussion should be undertaken with the cleaning material supplier. Removal of acidic traces should also be discussed with the cleaning material/product supplier.

Using acid based cleaners can be harmful to the person doing the work as well as the environment. Safety issues must be addressed.

Caustic Chemical Cleaning

This is a repeat of the above material. Cleaning with water can include using caustic materials, and, only after thorough testing. This should only be used on brickwork that is not prone to deterioration by using caustic chemicals, and, only after thorough testing. Great care and caution should be used with using caustic cleaners to prevent damage to the historic brickwork. Alkali cleaners are often used to remove oil based stains and paint. There is a saponification reaction with the oil based materials and an organic type of 'soap' is produced. All traces of chemical cleaners should be completely removed after cleaning has been effected. Caustic chemical cleaning often includes using a mild acid based wash. Caustic materials can often cause staining and efflorescence.

Product information for caustic based cleaners should be examined in detail and discussion should be undertaken with the cleaning material supplier. Removal of caustic traces should also be discussed with the cleaning material/product supplier.

Using caustic based cleaners can be harmful to the person doing the work as well as the environment. Safety issues must be addressed.

Chemical Cleaning

Chemical cleaning can be used for removing soiling from historic brickwork. The soiling is often in the form of a painted coating. Historically, some brickwork, received a coating that has failed and needs to be removed while other painted brickwork has received a coating that is inappropriate. The topic excludes the use of detergents, acidic cleaners, and caustic cleaners noted above. Removal of coatings is labourious and is often undertaken by manual cleaning. Care must be exercised to prevent damage to the brickwork substrate.

Paint can be removed from existing brickwork if unsightly or not in keeping with the heritage of the building. Care should be taken that the character of the heritage building is maintained. As a further caution, some of the earlier paints are lead based and can be toxic. Needlessly cleaning paint from existing brickwork should be avoided.

Chemicals can be used to soften, loosen, or remove the coating on masonry surfaces. Once the coating has been removed, it is necessary to apply a compatible and appropriate coating system.

The above methods can be used to provide a solvent for removal of local dirt or soiling. The solvent is included with an absorbent material and is called a 'poultice'. This type of objectional coating is often in the form of graffiti and is, generally, a local occurance. The solvent is mixed with an absorbant material that is often kaolinite, diatomacious earth, celulose, or some other inert absorbent material. This is placed in contact with the coating to be removed, and if a proper solvent is included, the offending coating is softened, dissolved and absorbed by the inert material. Using a poultice is very effective for removing graffiti.

Abrasive Cleaning

Brickwork should not be cleaned using abrasive cleaners. Abrasive cleaning included the use of electric sanding disks, belts, wet and dry grit, etc. Abrasive cleaners may be suitable for other types of masonry stonework, but not for brickwork. Non-staining and inert 'grit' such as dry ice, walnut shells, etc. can be used for stonework.

All cleaning should be undertaken using an established procedure. This can include:

location of a specialist brickwork cleaning contractor;

investigation of the brickwork, and

chemical testing of the brickwork;

investigation of the mortar, and chemical testing of the mortar, and a forensic chemist or chemical testing laboratory may be required for this testing;

presenting the obtained information to a cleaning supply specialist;

testing the cleaning process on a small obscured area;

if results are satisfactory, then proceed with the cleaning and remove all traces of cleaning method; and

provide a suitable coating system to protect the restored brickwork.

Evaluating the overall condition of the masonry to determine whether more than protection and maintenance are required, that is, if repairs to the masonry features will be necessary

-prepared by Dik Coates, P.Eng.
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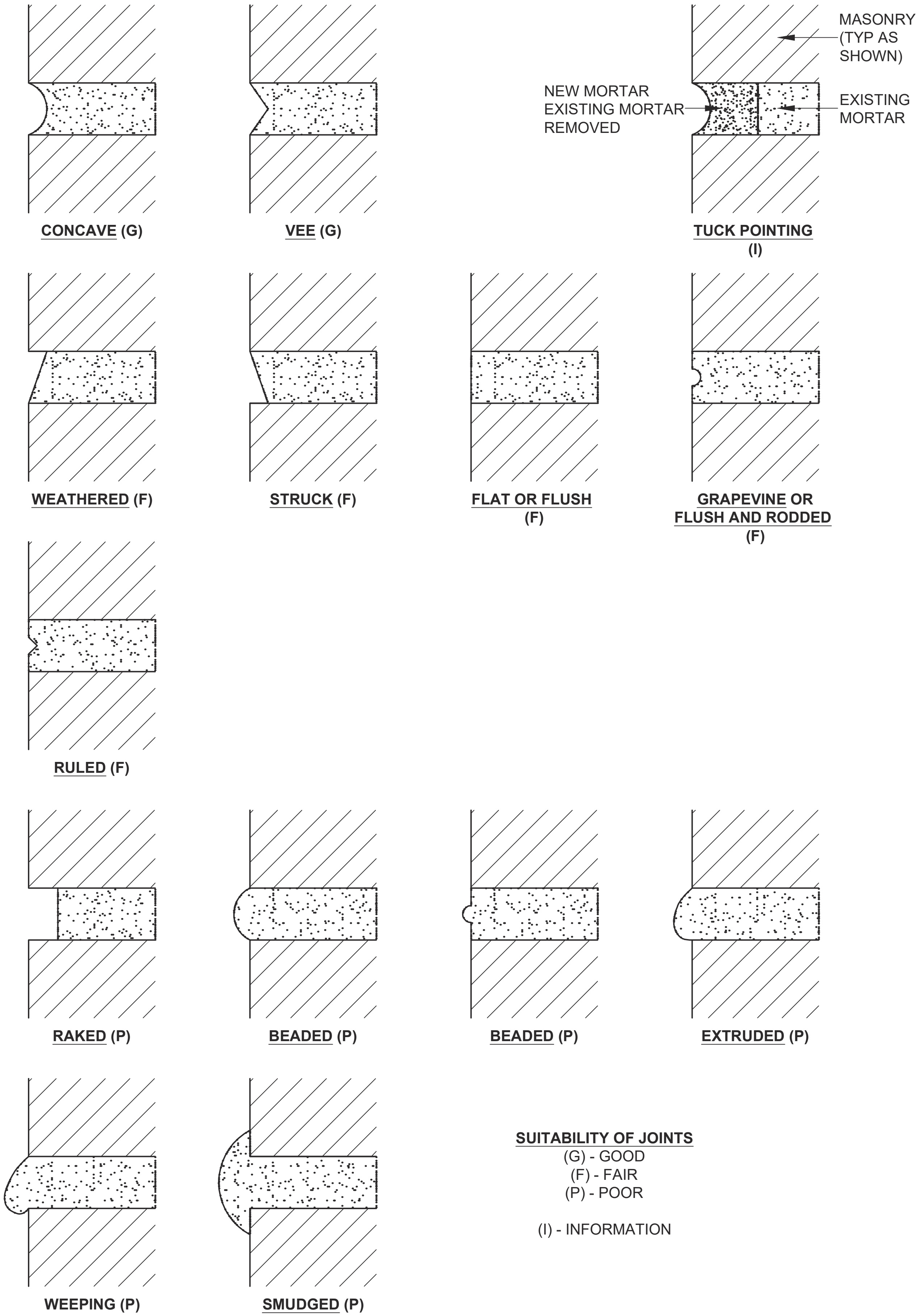
“Typically, every architect puts together a design of the work that he wants done,” said Vacala. “If it is a historical building in Chicago for instance, then they usually work with Landmarks Illinois (People Saving Places for People | Landmarks Illinois), who are very much in tune with restoring historic buildings properly and without changing the building’s existing materials.”
“Using different chemicals on a building can affect the building materials,” said Vacala. “It is best to get [a historical preservation group like] Landmarks Illinois involved and use properly trained professionals to conduct the work.”
“If you’re using a scrub brush and a very low PSI of a power washer to remove paint, then you can carefully take one layer off at a time. Scraping is even acceptable, if done correctly. There are also numerous new technologies on the market for removing existing paint, carbon build up or just years and years of dirt build up. But those can also be costly and sometimes over budget.”

While the process or technique is crucial in all masonry restoration projects, the chemicals and products that accompany the labor require the same level of competence and understanding. Vacala praised Jahn (Cathedral Stone Products | The Professional's Choice for Masonry Restoration & Repair) for offering training to ensure the correct use of its products.



MASONRY MORTAR JOINTS

SCALE: NTS