THE BRICK INDUSTRY ASSOCIATION

TECHNICAL NOTES on Brick Construction

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Water Penetration Resistance – Construction and Workmanship

Abstract: This *Technical Note* covers essential construction practices needed to ensure water-resistant brick masonry. Procedures for preparing materials to be used in brick construction are recommended, including proper storage, handling and preparation of brick, mortar, grout and flashing. Good workmanship practices are described, including the complete filling of all mortar joints, tooling of mortar joints for exterior exposure and covering unfinished brick masonry walls to protect them from moisture.

Key Words: air space, brick, construction, flashing, initial rate of absorption, joints, mortar, tooling, weeps, workmanship.

SUMMARY OF RECOMMENDATIONS:

General

- Store materials on job site to avoid wetting, contamination and temperatures outside manufacturer limits
- For drainage walls, keep the air space free of excessive mortar droppings
- Do not disturb newly laid masonry
- Stop in-progress brickwork by stepping back courses to create a diagonal profile
- Cover tops of unfinished walls until adjacent construction protects them from water ingress

Brick and Mortar

- Distribute brick from different straps and cubes around jobsite to blend brick
- Lab test values for the initial rate of absorption (IRA) of a given brick may vary among different production runs and different field exposures
- For brick with an IRA lower than 5 g/min•30 sq in. (5 g/min•194 cm^2), mortar with reduced water or minimized water retention by decreasing lime proportions within limits of ASTM C270 is recommended
- For brick with an IRA exceeding 30 g/min•30 sq in. (30 g/min•194 cm^2):
  - Mortar with increased water or maximized water retention by increasing lime proportions within limits of ASTM C270 is recommended
  - When used on a building designed to the *IBC*, pre-wet brick where feasible; otherwise, modify mortar mix to maximize water retention
- When mixing mortar, use accurate batching measurements and the maximum amount of water that produces a workable mortar
- For colored mortars, follow manufacturer's recommended procedures

Joints

- In exterior wythes, completely fill all mortar joints intended to have mortar
- Minimize furrowing of bed joints and prohibit slushing of head joints
- Fill collar joints completely with grout or mortar, preferably grout; do not slush collar joints
- Tool mortar joints when thumbprint hard with a concave, "V" or grapevine jointer

Mock-Ups and Sample Panels

- For residential construction, use an as-built dwelling by the same builder or mason contractor to establish workmanship
- For commercial construction, sample panels or mock-ups are recommended
- For commercial construction that has complicated facades with multiple cladding materials or that requires field testing, a mock-up is preferred

Flashing and Weeps

- Do not stop flashing behind face of brickwork
- Where required, turn up flashing ends into head joint a minimum of 1 in. (25.4 mm) to form end dams
- Lap continuous flashing pieces at least 6 in. (152 mm) and seal
- Where installed flashing is pierced, make watertight with sealant or liquid membrane compatible with flashing
- Install weeps immediately above flashing
- Install vertical leg of flashing behind water-resistive barrier sheet
- Install vertical leg of flashing over fluid-applied or self-adhered air/vapor barriers or per manufacturer's directions

Water-Resistive Barrier

- Seal penetrations from ties, anchors and termination bars
- Avoid damaging with trowels, and repair any damage as soon as possible before concealed

INTRODUCTION

The best design, detailing and materials will not compensate for poor construction practices and workmanship. Proper construction practices, including preparation of materials, are essential to achieve a water-resistant brick masonry wall.

This *Technical Note* discusses construction techniques and workmanship and is the third in a series of *Technical Notes* addressing water penetration resistance of brick masonry. Other related *Technical Notes* address brickwork design and details (TN 7), materials (TN 7A) and condensation (TN 47). Maintenance of brick masonry is addressed in *Technical Note* 46. All of these items are essential to obtain water-resistant brick masonry walls.

PREPARATION OF MATERIALS

Preparation of masonry materials before bricklaying begins is very important. Specific procedures must be followed to ensure satisfactory performance and to avoid problems. Preparation includes material storage, mixing mortar and grout, and in some cases wetting the brick.

Delivery and Storage of Materials

Masonry units are generally delivered to the site strapped in packs or cubes that are commonly on pallets. Movement of these packages around the site should be performed using methods and equipment that will limit damage to the masonry units. All materials at the jobsite should be stored off the ground to avoid damage and contamination from dirt, groundwater or other matter that may cause stains and contain soluble salts that contribute to efflorescence. Masonry units, mortar materials, ties and reinforcement should be stored off the ground, preferably in a dry location. In addition, all materials should be covered with tarps or other water-resistant materials to protect them from rain, snow and other elements. In addition, cover sand and other aggregates with a water-resistant membrane to avoid saturation and freezing in cold weather, as well as runoff and segregation of aggregates. Store flashing materials in places where they will not be punctured or damaged, and keep UV-sensitive materials in areas away from sunlight. Store roll materials on ends to avoid creasing. Store masonry accessory materials such as flashing components and joint sealant in unopened containers with labels at a location where temperatures will remain within the manufacturer's required range. All masonry materials must be stored to prevent freezing, as indicated in *Technical Note* 1.

Wetting Brick

Brick with an initial rate of absorption (IRA) greater than 30 g/min•30 sq in. (30 g/min•194 cm^2) at the time of laying tend to draw too much moisture from the mortar before initial set, which can result in cracking and poor bond. To increase bond and water penetration resistance, construction practices may need to be altered when using such brick. ASTM C67, *Test Methods for Sampling and Testing Brick and Structural Clay Tile* [Ref. 1], includes a standard procedure for measuring IRA. However, be aware that some coatings, surface treatments and textures can return an elevated IRA value in laboratory tests while not adversely affecting water content of the mortar in the field. In addition, the IRA of a given brick may vary by production run and by exposure at the site.

A crude method to determine whether brick have an elevated IRA consists of drawing, with a wax pencil, a circle 1 in. (25.4 mm) in diameter on the brick surface that will be in contact with the mortar. A quarter can be used as a guide for the circle. With a medicine dropper, place 20 drops of water inside this circle and note the time required for the water to be absorbed. If the time exceeds 1½ min, then setting the brick with typical methods should suffice; if less than 1½ min, then adjustments to typical construction practice are recommended.

The *International Building Code* (*IBC*) [Ref. 5] references the *Specification for Masonry Structures* (TMS 602) [Ref. 6] which requires brick with an IRA exceeding 30 g/min•30 sq in. (30 g/min•194 cm^2) to be wetted prior to laying to produce an IRA less than 30 g/min•30 sq in. (30 g/min•194 cm^2) when the units are placed. However, execution of this method may be impractical on large-scale construction projects, and the contractor may consider modifying the mortar mix to maximize water retention, as discussed in "Mixing of Mortar and Grout" in this *Technical Note*.

If brick are to be wetted, the method of wetting is very important. Sprinkling or dipping the brick in a bucket of water just before laying would produce the surface wet condition, as shown in Figure 1b, which may not be

sufficient. The units should have a saturated interior but be surface dry (also referred to as “saturated surface dry”) at the time of laying, as shown in Figure 1d.

Satisfactory procedures for wetting the brick consist of letting water run on the packs or cubes of brick, or placing them in a large tank of water. This should be done the day before the units are laid, or not later than several hours before the units will be used, so that the surfaces have an opportunity to reach a surface dry condition before the brick are laid. Wetting low-absorption brick or excessive wetting of brick may result in saturation, as shown in Figure 1c. This may prevent adequate absorption of water, resulting in excess moisture or “bleed” from the mortar joints and cause the brick to slide more readily—a condition commonly referred to by masons as “floating” of the brick.

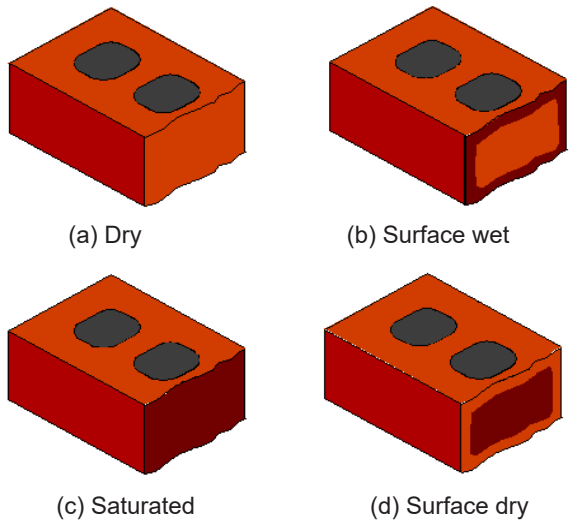

Figure 1
Moisture Content of Brick

Mixing of Mortar and Grout

Typically, a high water content in the mortar is necessary to obtain complete and strong bond between mortar and brick. In general, the mortar should be mixed with the maximum amount of water that produces a workable mortar. Factors such as the jobsite environment and the IRA of the brick should be considered when determining the proper amount of water to include in the mortar.

Mortar to be used with brick that have an IRA greater than 30 g/min•30 sq in. (30 g/min•194 cm^2) should be mixed to maximize water retention by increasing mixing water or lime content within the limits of ASTM C270, *Standard Specification for Mortar for Unit Masonry* [Ref. 2]. This is particularly important when pre-wetting the brick to reduce the IRA is impossible or impractical. Admixtures designed to increase the water retention of the mortar may also be used to improve the compatibility of mortar with high-IRA brick. Only admixtures with test data showing no deleterious effects should be used.

Mortar for use with brick that have an IRA less than 5 g/min•30 sq in. (5 g/min•194 cm^2) should be mixed with reduced amounts of water or lime to minimize water retention. Lime proportions should remain within the limits of ASTM C270.

When brick with widely different absorption rates are used together in brickwork, it is important to maintain the correct water content in the mortar used with the different brick.

All cementitious materials and aggregates must be mixed for at least three minutes and not more than five minutes in a mechanical batch mixer. If, after initial mixing, the mortar stiffens due to the loss of water by evaporation, then additional water should be added and the mortar remixed (retempered). Pigmented or colored mortars are sensitive to retempering, which can result in significant color variations. Consult the colored mortar manufacturer’s literature for requirements and recommendations that may vary from standard practice. All mortar should be used within 2½ hr (2 hr in hot-weather conditions, see *Technical Note* 1) of initial mixing, and grout should be used within 1½ hr of introducing water into the mix. No mortar or grout should be used after it has begun to set.

One of the most common problems with mortar is oversanding. Oversanded mortar is harsh and unworkable, and results in poor extent of bond and reduced bond strength, increasing the potential for water penetration problems. The cause of oversanding is frequently due to the shovel method of measuring the sand. The amount of sand that a shovel will hold varies depending on the moisture content of the sand, the person doing the shoveling and the different sizes of shovels used on jobsites. To alleviate this problem, proper batching methods must be used. Measurement of sand by shovel should not be permitted. Instead, a bucket or box of known volume will provide more consistent results. *Technical Note* 8B provides detailed guidelines for various methods of more accurately batching mortar.

Blending of Brick

While not related to water penetration resistance, blending of brick at the jobsite is an important preparation task related to workmanship and the acceptable appearance of brickwork. Because brick is made from natural materials that differ in physical properties, variations in color may occur between production runs and occasionally within the same run. Modern manufacturing processes use automatic equipment that may not permit inspection of each brick unit, resulting in minor color and texture variations. For these reasons, straps of brick from different cubes should be placed together around the wall. The mason should then select brick from adjacent straps when laying a given section of brickwork. By blending the brick throughout the wall in this manner, the effect of potential color variations on the finished brickwork is minimized.

WORKMANSHIP

The importance of good workmanship to attain quality brickwork cannot be overemphasized. While design and the quality of materials contribute to the water penetration resistance of brickwork, workmanship is a highly important factor in the construction of water-resistant masonry.

Mock-Ups and Sample Panels

Building a mock-up or sample (field) panel on-site prior to the start of construction can provide a tangible reference of the quality and level of workmanship to be expected on the project for the building owner and the construction team. Although more common in commercial construction, sample panels or mock-ups may be considered for a custom residential project. For one- and-two-family residential construction where mock-ups or sample panels are not provided, an as-built dwelling in the same development or one constructed by the same builder or mason subcontractor may be used as a basis of workmanship.

The brick used in a sample panel or mock-up is intended to demonstrate the final brick texture, color range, bond pattern and mortar color. Any issue with the brickwork must be resolved before the panel is accepted. Once the sample panel or mock-up is accepted, it becomes the standard for quality for all brick and brickwork on the project and should be used as a reference for bond pattern, brick, mortar joints, workmanship, and general appearance. A sample panel is intended only to show the brickwork. It is important that all aspects of the brickwork are shown in the sample panel, such as filling and tooling all mortar joints and cleaning the brick. Typically, sample panels give the best overall indication of the final brickwork.

A mock-up is generally larger than a sample panel because it includes more elements than brick and mortar and is intended to show the relationship between the brickwork and other facade elements, like doors and windows (fenestration) and other cladding materials. A mock-up includes all the underlying components of the wall assembly, such as air/vapor barriers, flashing and veneer anchors. By including these elements, the installation methods of these items can be evaluated and varied as required to achieve the desired results. On large commercial projects, this mock-up is often subjected to field testing in order to evaluate the performance of the wall assembly and the fenestration with respect to water and air penetration.

Subcontractors involved with constructing the mock-up include all trades associated with installing these elements in the building. Similar to a sample panel, a mock-up sets the project standard for appearance and workmanship. Work that is subsequently concealed as part of the mock-up construction should be photographed and the images maintained on-site for reference during the project.

Placing Flashing and Weeps

Flashing must be installed properly and integrated with adjacent materials to form an impervious barrier to moisture migration to the interior of the building. The flashing should be wide enough to start outside the exterior face of the brick wythe, extend across the cavity, and turn up vertically against the backing or interior wythe at least 8 in. (203 mm). The top (vertical) edge should be placed in a mortar joint of the inner wythe, in a reglet in concrete backing, or attached to sheathing or backing with a termination bar, as shown in Figure 2. Some manufacturers of self-adhered flashing permit termination with a compatible sealant bead encapsulating the leading edge. The vertical leg of the flashing is generally installed behind a water-resistive barrier and over a fluid-applied membrane or self-adhered sheet membrane air barrier/vapor retarder. Manufacturers' details for the water-resistive barrier, air barrier and/or vapor retarder should be consulted for recommended installation.

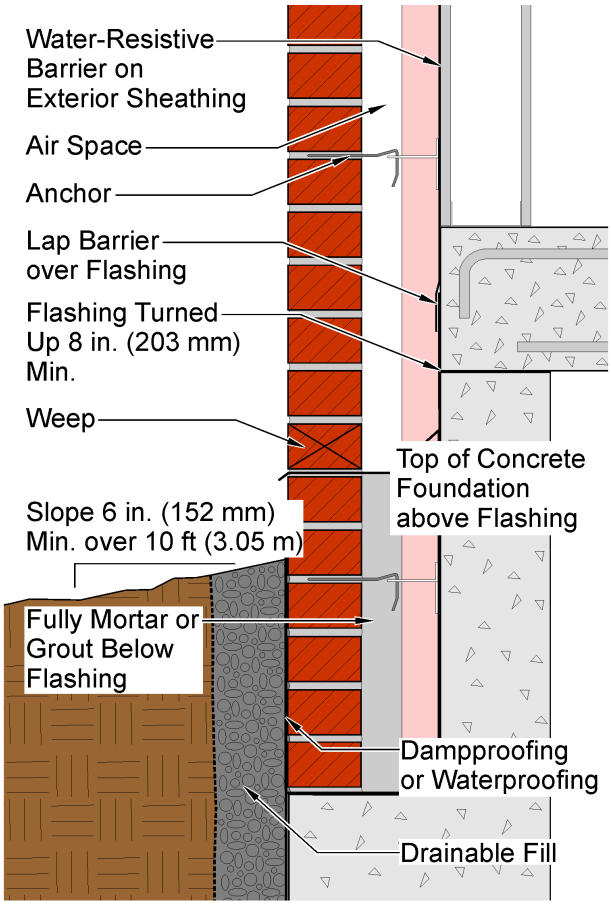

Figure 2
Placing Flashing and Weeps

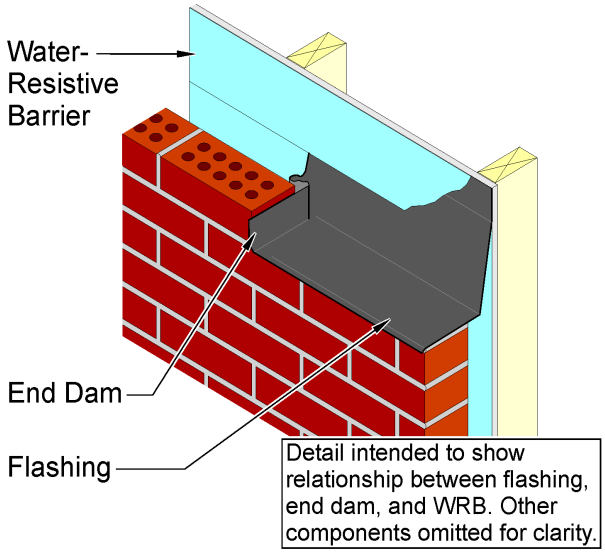

Figure 3
End Dam Detail

As a general rule, sections of flashing are to be overlapped at least 6 in. (152 mm) and the lap sealed with a compatible adhesive. Water-resistant sheet membranes should overlap the flashing in a shingled fashion by at least 6 in. (152 mm). Manufacturers' installation requirements for specific flashing materials may vary from these recommendations and should be consulted.

Flexible flashing is placed so that the outside edge projects from the face of the wall. Although the formation of a drip is recommended, this flashing may be cut flush with the face of the brickwork. Sheet metal flashings are intended to project past the face of the wall and form a drip. In no circumstances should the flashing be stopped behind the face of the brickwork. Continuity at corners and returns is achieved by cutting and folding straight sections or using preformed corner pieces. Discontinuous flashing should terminate with an end dam in a head joint and turn up at least 1 in. (25.4 mm), as shown in Figure 3.

Flashing must be placed without punctures or tears. Openings created for reinforcement or anchors must be protected with application of a compatible sealant. Care should be exercised to ensure full coverage of any membrane, adhesive or sealant around penetrations or protrusions, such as brick veneer anchors at the point of contact with the wall. Many self-adhered membrane flashing manufacturers offer such a sealant as an accessory to the system. Additional protection may be needed around bolts fastening shelf angles to the structure.

Weeps are required and should be placed in mortar joints immediately above the flashing. Open head joints, formed by leaving mortar out of a joint, are the recommended type of weep. Open head joint weeps should be at least 2 in. (51 mm) high. Noncorrosive metal, mesh or plastic screens can be installed in open head joint weeps if desired. Weep openings are permitted by most building codes to have a minimum diameter of 3⁄16 in. (4.8 mm). This smaller opening results in reduced drainage capability and increased risk of clogging; therefore, use of tube weeps is discouraged. The practice of specifying the installation of weeps one or more courses of brick above the flashing is not recommended, as it requires a head of water to accumulate on the flashing before drainage can occur. Noncorrosive metal, mesh or plastic screens can be installed in open head joint weeps if desired.

Spacing of open head joint weeps at no more than 24 in. (610 mm) o.c. is recommended. If used, spacing of wick weeps is recommended at no more than 16 in. (406 mm) o.c. These are closer spacings than the 33 in. (838 mm) o.c. spacing permitted by most building codes; however, they improve drainage. Ensure that weeps are clear of all mortar to allow the wall to drain. Rope wicks should be flush with, or extend ½ in. (12.7 mm) beyond, the face of the wall to promote evaporation. The rope should continue into the bottom of the air space, placed along the back of the brick, and be at least 16 in. (406 mm) long.

Tie/Anchor Installation

With respect to water penetration resistance, protecting ties and anchors from corrosion is critical. Anchors for veneer require a minimum mortar cover of ⅝ in. (15.9 mm). This cover requirement also applies to longitudinal wires of joint reinforcement. Where this cover cannot be achieved in non-veneer applications of hollow units, placement of the wire tie or joint reinforcement in center of face shell is recommended. See the "Interface with Water-Resistive Barrier" section of this *Technical Note* for information regarding fasteners used with face-mounted ties and treatment of penetrations caused by these fasteners. For more information on ties and anchors, including spacing, corrosion resistance and material specifications, refer to *Technical Note* 44B.

Interface with Water-Resistive Barrier

Multiple elements of masonry veneer are in contact with or penetrate the water-resistive barrier, which also may serve as an air barrier and vapor retarder. These elements are intended to prevent moisture ingress to the interior and damage to the backing.

Brick ties or anchors penetrate this layer and flashing is applied to it or under it. If a termination bar is used, then its fasteners will penetrate this layer as well. Sealing penetrations is critical. It is preferable to place sealant behind ties or anchors, termination bar fasteners and other items that penetrate these layers. Applying the sealant as these items are being installed is necessary and generally done by the mason.

Once laying of brick has begun, there is additional risk of tearing or scraping the water-resistive barrier due to the mason working in close proximity to the layer. Breaches in the water-resistive barrier have the potential to permit ingress of bulk water and moisture-laden air, which can cause significant damage to the underlying materials. Therefore, the mason should coordinate with the installer of the water-resistive barrier if this work was performed by others in order to quickly repair any damage that occurs before it is concealed.

Filling Mortar Joints

To reduce water penetration, there is no substitute for proper filling of all mortar joints that are designed to receive mortar. Improperly filled mortar joints can result in leaky walls, can reduce the strength of masonry, and may contribute to disintegration and cracking due to water penetration and subsequent freezing and thawing. This behavior and performance has been confirmed by extensive laboratory tests [Ref. 4] as well as observations of masonry buildings in service.

A uniform bed of mortar should be spread over only a few brick units, and furrowed lightly, if at all. Filled joints result when plenty of mortar is placed on the end of the brick unit to be laid and it is shoved into place so that mortar is squeezed out of the top of the head joint, as shown in Photo 1. After placement, mortar squeezed out of the bed joint should be cut off prior to tooling, as shown in Photo 2. When placing closures, plenty of mortar is needed on the ends of brick in place and on the ends of the brick to be laid. The closure should be shoved into place without disturbing brick on either side, as shown in Photo 3.

Photo 1
Shoving Brick into Place

Photo 2
Cutting Excess Mortar

Photo 3
Placing the Closure

Bed Joints. A bed joint is the horizontal layer of mortar on which brick are laid. The length of time between placing the bed joint mortar and laying the succeeding brick influences the resulting bond. If too much time elapses, then poor extent of bond will result. Brick should be laid within about 1 minute after the mortar is placed.

Full bed joints (covering the entire bedding surface) are an inherent requirement for water-resistant brick masonry construction. For solid brick, bed joints should be constructed without deep furrowing of the mortar. For hollow brick used in a veneer application, full bed joints are recommended. For ungrouted hollow brick in non-veneer applications, full bed joints provide the highest level of water penetration resistance. However, bed joints in this application may be laid with face shell bedding (mortar placed only on the front and back face shells) and still provide adequate water penetration resistance. Both face shells must be completely covered with mortar.

Head Joints. A head joint, sometimes called a cross joint, is the vertical mortar joint between two brick units. For both solid and hollow brick, it is important that head joints be completely filled. The best head joints are formed by completely buttering the ends of the brick with mortar and shoving the units into place against previously laid brick.

"Slushing" (throwing mortar into the joint with the edge of a trowel) does not adequately fill joints or compact the mortar, resulting in joints that are less resistant to water penetration. Examples of methods used to form head joints are shown in Figure 4.

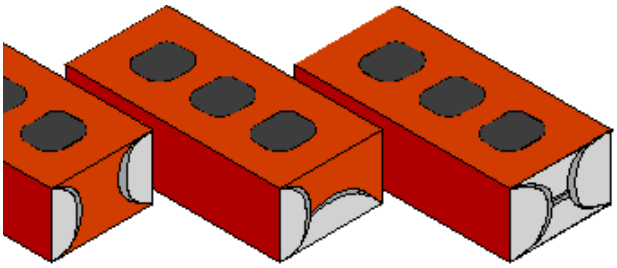

Figure 4
Head Joints

Tooling of Mortar Joints

Proper tooling, or "striking," of mortar joints helps to seal the wall surface against moisture penetration. Mortar joints should be tooled when they are "thumbprint" hard, (pressing the thumb into the mortar leaves an indentation, but no mortar is transferred to the thumb) with a jointer slightly larger than the joint. It is important that joints are tooled at the appropriate time, as this affects both their effectiveness and appearance. The duration to achieve thumbprint-hard mortar may vary throughout the work day. Joints that are tooled too early often smear mortar onto the adjacent brick and result in rough-surfaced joints. If tooling is delayed too long, however, the surface of the joint cannot be properly consolidated and bonded to the adjacent brick. Each portion of the completed brickwork should be allowed to set for the amount of time necessary to achieve thumbprint-hard mortar before tooling in order to ensure a uniform mortar shade. Early tooling often results in joints of a lighter color. Later tooling results in darker shades.

Concave, "V" and grapevine joints (Photo 4 and Photo 5) best resist water penetration in exterior brickwork. These joints produce a dense and weather-tight surface, created as the mortar is pressed against the brick and consolidated during tooling. For interior masonry work, other joints such as the weathered, beaded, struck, flush,

Photo 4
Concave Mortar Joints

Photo 5
"V" Mortar Joints

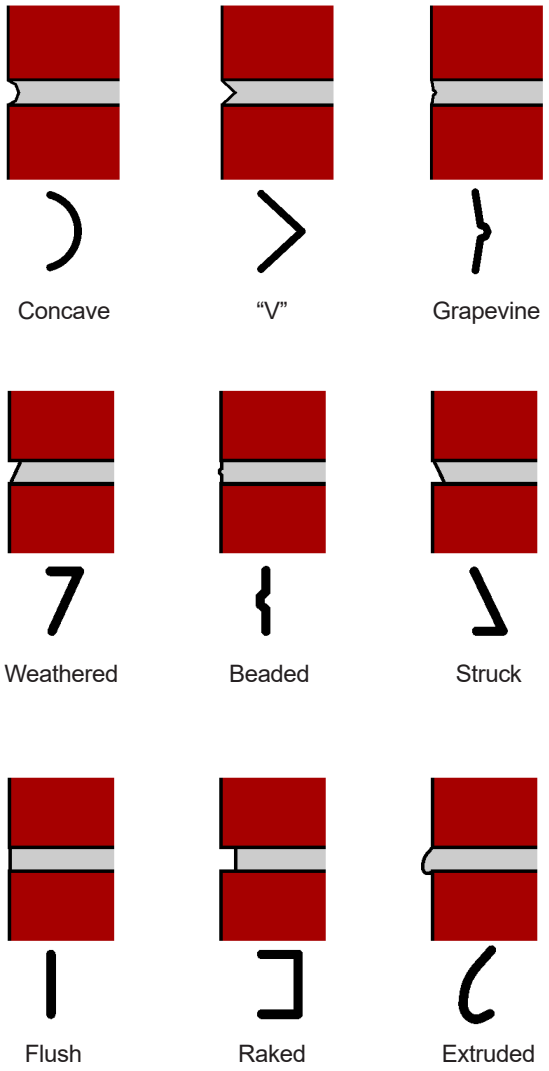

Figure 5
Types of Mortar Joints

Photo 6
Poorly Filled Collar Joint

raked or extruded joints shown in Figure 5 also may be used. These joints are not recommended for exterior use because the methods used to form them do not consolidate the outer portion of mortar, or they create horizontal ledges on which water can pond and saturate the masonry.

Collar Joints

The vertical, longitudinal joints between wythes of masonry are called collar joints. The manner in which these joints are filled is very important. Grouting is the most effective method of ensuring that collar joints are completely filled. However, grouting in spaces less than ¾ in. (19.1 mm) wide is not permitted. Mortar protrusions (fins) that extend more than ½ in. (12.7 mm) into a cell or cavity that will be grouted must be removed prior to grouting. For mortar-filled collar joints, the outer face of the inner masonry wythe should be parged and the back of brick in the exterior wythe buttered in order to fill the collar joint.

"Slushing" of collar joints is not effective because it does not completely fill all voids in the joint, as shown in Photo 6. Frequently, the mortar is caught and held before it reaches the bottom of the joint, leaving openings between the face brick and the backing. Even when this space is filled, there is no way to compact the mortar. The mortar does not bond with the brick over its entire surface, and channels are left between the mortar and the brick. Some of these channels may allow water to reach the back of the wall. A properly constructed collar joint is completely filled with grout or mortar.

Parging

Parging is the process of applying a coat of portland cement mortar to masonry. Parging the outer face of the inner wythe of a multi-wythe wall with Type M or S mortar as dampproofing may help resist rain penetration and can also reduce air leakage. Membranes or fluid-applied materials usually provide superior performance to parging, which will crack if the wythe cracks. Once cracked, the parging loses most of its effectiveness. However, parging can provide a smooth base for these materials. If parging alone is to resist water penetration, then proper curing is necessary to reduce shrinkage cracks. Parging the back side of the exterior wythe is not recommended for drainage-type walls, as this may result in more debris in the air space.

The face of the wall to be parged must not have any mortar protrusions. Protruding mortar can cause bond breaks in the parge coat, resulting in a leaky wall. When applied in multiple layers, each should be a minimum thickness of ¼ in. (6.4 mm). The first coat should be allowed to partially set,

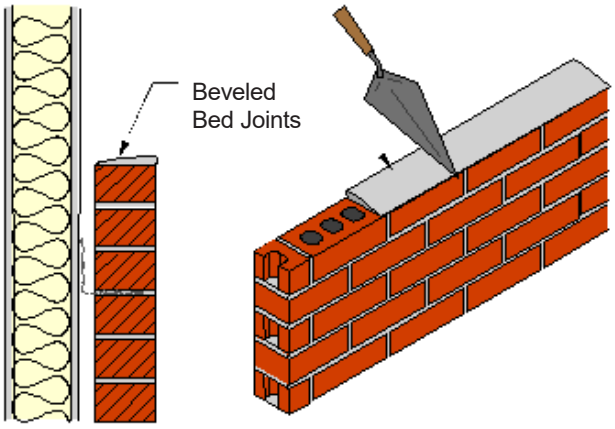

Figure 6
Beveled Bed Joints

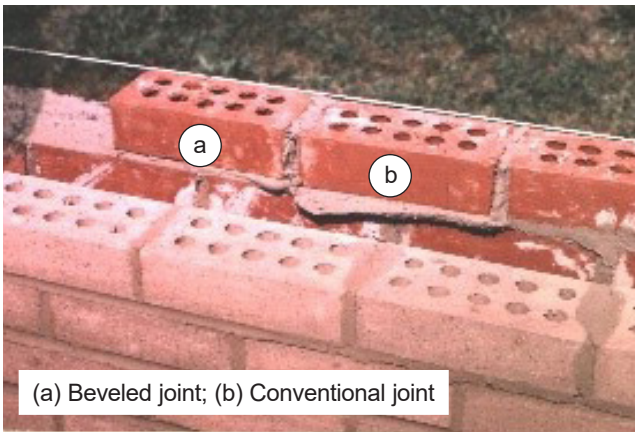

Photo 7
Beveled and Conventional Mortar Joints

roughened and allowed to cure for 24 hours. It is then moistened for application of the second coat. The parged surface should be troweled smooth so that it sheds water easily. When completed in adjacent areas, the edges of the parging should be feathered, and new parging should overlap existing parging by a minimum of 6 in. (152 mm). Lap joints should be spaced no closer than 6 ft (1.83 m).

Constructing a Functional Air Space

In a drainage wall system, such as a cavity wall or an anchored veneer wall, it is essential that the air space be kept as clear of mortar droppings as possible. If it is not, then mortar droppings may clog the weeps, protrusions may span the air space (mortar bridging) and water may penetrate to the interior.

To the greatest extent possible, mortar droppings should be prevented from falling into the air space or cavity. Good workmanship can go a long way to minimize the occurrence of mortar droppings. However, it is unreasonable to expect a mason to maintain a cavity completely clear of mortar droppings or protrusions. Therefore, an air space that provides drainage is permitted to contain mortar from construction. An aid to prevent mortar droppings is to bevel the bed joint away from the air space or cavity, as shown in Figure 6. When brick are laid on a beveled bed joint, a minimum of mortar is squeezed out of the joint, as shown in Photo 7. The mortar squeezed from the joints on the air space or cavity side may be troweled onto the units. This same procedure may be used for laying the exterior wythes of grouted and reinforced brick cavity walls.

Another method allows access to the base of the cavity for cleaning. When the brickwork is initially constructed, every third or so brick unit in the course above the flashing of the exterior wythe is omitted. Once the brickwork is complete, mortar droppings at the base of the cavity can be easily removed and weeps provided when the omitted brick are placed in the wall with mortar.

Drainage materials and mortar collection devices (mortar dropping collection devices) may also be used to keep the air space adjacent to the weeps free from mortar. The use of a mortar collection device in combination with good workmanship to maintain an unobstructed cavity is an effective method to ensure functional moisture management and is becoming standard practice in the industry. The use of a mortar collection device does not eliminate mortar bridging or absolve the mason from minimizing mortar droppings in the cavity.

Disturbance of Newly Laid Masonry

Newly laid brick should never be pushed, shoved, tapped or otherwise disturbed once they are laid in their final position and the mortar has begun to set. Any disturbance at this point will break the bond and may lead to a leak. If adjustments are necessary, then the incorrectly placed brick should be removed and relaid in fresh mortar.

Unfinished Brickwork

When brickwork progress ends in the field of the wall, it is recommended to stop horizontal runs with a setback of one-half unit length over each course below, creating a diagonal end profile. By doing so, when work begins

again, the new brick are laid as normal. Ending work in a toothed profile results in more effort when work resumes, requires pointing bed joints for the projecting units, and creates a condition where achieving full joints and good bond is difficult, increasing the risk of water penetration.

Covering of masonry walls at the end of each work day, and especially in times of inclement weather, is essential for satisfactory performance. Otherwise, excessive moisture enters the wall system, requiring an extended drying period and increasing the risk of persistent efflorescence. Covering unfinished walls with tarps or other water-resistant materials, securely tied or weighted to adequately resist wind, should be rigorously enforced. Mortar boards, scaffold planks and light plastic sheets (less than 10 mils thick) weighted with brick should not be accepted as suitable cover. Metal clamps, similar to bicycle clips, are commercially available in a variety of sizes to meet various wall thicknesses. These are used in conjunction with plastic sheets or water-repellent tarps and offer excellent protection for extended periods of time.

Tops of walls should also be covered after the mason's work is finished if a permanent coping is not attached immediately after the brickwork is completed. Coverings extending 24 in. (610 mm) down the vertical face on each side are recommended and should be maintained until the wall construction is completed or protected by adjacent materials. Protection of openings in brickwork such as those for windows, movement joints, etc. should also be considered, as they may allow moisture ingress from rain and snow and can lead to moisture-related problems such as efflorescence and in some cases could affect the final mortar color.

Poor wall performance can sometimes be attributed to the freezing of mortar before it has set, or the lack of protection of materials and walls during cold weather construction. Therefore, when building in cold weather, proper protection against freezing is required for all materials and walls under construction, as indicated in *Technical Note* 1 and in TMS 602.

SUMMARY

Quality construction practices and good workmanship are essential to achieve brickwork that is resistant to water penetration. This *Technical Note* does not cover all construction practices but describes material storage, preparation procedures, construction practices and installation techniques that are indicative of high quality and, when combined with proper design, detailing and materials, result in brickwork that is resistant to water penetration.

> *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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