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Water Penetration Resistance - Materials

Abstract: This *Technical Note* discusses considerations for the selection of materials used in brickwork and their impact on its resistance to water penetration. Minimum recommended property requirements and performance characteristics of typical materials are described.

Key Words: anchors, brick, coatings, corrosion resistance, flashing, grout, lintels, mortar, sealants, shelf angles, ties, water-resistant barrier, weeps

SUMMARY OF RECOMMENDATIONS:

Brick and Mortar:
- Select brick from the appropriate ASTM standard, designated for exterior exposures
- Choose mortar materials and types that are compatible with the brick selected
- Use mortar type with lowest compressive strength meeting project requirements

Ties and Anchors:
- Use galvanizing, stainless steel or epoxy coatings to provide corrosion resistance

Water-Resistant Barriers:
- Install when brick veneer is anchored to wood or steel studs
- Protect from or avoid prolonged ultraviolet (UV) exposure
- Use No. 15 asphalt felt conforming to ASTM D 226 or building paper, polymeric films (building wraps) or water-resistant sheathings deemed equivalent or conforming to AC 38
- Tape or seal all joints of insulation or sheathings with facings intended to act as a water-resistant barrier

Flashing:
- Select flashing that is waterproof, durable, UV resistant and compatible with adjacent materials
- Flashing materials should conform to applicable ASTM specifications
- Do not use aluminum, sheet lead, polyethylene sheeting or asphalt-saturated felt, building paper or house wraps
- Use a metal drip edge to extend flashings that degrade when exposed to UV light

Weeps:
- Open head joint weeps recommended

Sealant Joints:
- Use backer rods in joints wide enough to accommodate them.
- Use sealants meeting the requirements of ASTM C 920 for joints subject to large movements

INTRODUCTION

This *Technical Note* is the second in a series addressing water resistance of brick masonry and provides guidance regarding material selection of brick masonry components. Other *Technical Notes* in the series address brickwork design and details (7), construction techniques and workmanship (7B) and condensation (7C and 7D).

The use of quality construction materials in brickwork is of prime importance in attaining a satisfactory degree of water resistance. Requiring that materials meet the minimum criteria of appropriate material specifications helps to ensure that they are of an acceptable quality.

The most recognized and widely used building material specifications for the determination of quality construction materials are those developed by ASTM International (ASTM). The requirements of ASTM specifications alone cannot predict performance levels of products because they are also affected by design, detailing and workmanship. However, the requirements are based on laboratory tests and field experience and, in the case of brick, are the result of experience gained over a time span exceeding 100 years.

BRICK UNITS

Selection of quality brick is very important. Units are normally chosen based on color, texture, size and cost. However, characteristics that can affect water penetration resistance should also be considered. These include durability and those properties that influence brick/mortar compatibility.

Under normal exposures, it is virtually impossible for significant amounts of water to pass directly through brick units. Brick may absorb some water, but this does not contribute to an outright flow of water through the brickwork.

Durability

Because exterior masonry will be exposed to moisture and the elements, durability is a primary concern. Durability of the brickwork is affected not only by the durability of individual materials, but also the compatibility of materials, how the assembly is designed, how materials are installed and the conditions to which the masonry is exposed.

The ASTM specifications for brick are written to provide guidance in choosing a suitable quality of brick based on specific exposure conditions. The requirements for compressive strength, absorption and saturation coefficient are established to indicate the resistance of the brick to damage by freezing and thawing when saturated. Cracking, crazing, spalling and disintegration can occur if an improper choice of brick is made.

The ASTM requirements are not intended to serve as an indicator of the degree of water resistance of the masonry. The degree of water resistance is related to the durability of the masonry insofar as the more water that enters the system, the greater the probability that the masonry will be in a saturated condition during freeze/thaw cycles.

Brick Standards. Each kind of brick currently in use has its own designated ASTM standard, with specific requirements for durability stipulated by physical properties of the brick. The most commonly used brick standards and the classification for the most severe exposures are:

ASTM C 216, Grade SW - Facing Brick (Solid Masonry Units Made From Clay or Shale)

ASTM C 652, Grade SW - Hollow Brick (Hollow Masonry Units Made From Clay or Shale)

ASTM C 62, Grade SW - Building Brick (Solid Masonry Units Made From Clay or Shale)

ASTM C 1405, Class Exterior - Glazed Brick (Single Fired, Brick Units)

ASTM C 126, (does not include physical requirements for the brick body, use Grade SW within ASTM C 216 or C 652) - Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units

MORTAR AND GROUT

Choosing the proper type of mortar or grout to use in a particular application is very important. To minimize water penetration the primary concern is to choose a mortar and/or grout that will result in the most complete bond with the masonry units chosen. The *Technical Notes* 8 Series provides detailed information on mortar. *Technical Note* 3A provides further information on grout.

Mortar

The most commonly used standard for specifying mortars for unit masonry is ASTM C 270. Four types of mortar (M, S, N and O) are covered in the standard, although building codes typically require the use of Types M, S or N. ASTM C 270 addresses mortars made with portland cement-lime combinations and those made with mortar cements and masonry cements. Detailed information on ASTM C 270, mortar types and properties can be found in *Technical Note* 8.

No single type of mortar is best for all purposes. The basic rule for the selection of a mortar for a particular project is: Always select the mortar type with the lowest compressive strength that meets the performance requirements of the project.

This general rule must be tempered with good judgment. For example, it would be uneconomical and unwise to continuously change mortar types for various parts of a structure. However, the general intent of the rule should be followed, using good judgment and economic sense. For most brick veneer applications, Type N mortar is appropriate.

Grout

In some barrier masonry walls, grout is used to form a collar joint that bonds the outer and inner masonry wythes together. Collar joints are the primary means of providing water penetration resistance in contemporary barrier wall construction. When properly constructed, collar joints provide a solid cementitious layer deterring water entry into the inner masonry wythe.

Grout for brickwork should conform to ASTM C 476. Two types of grout, fine and coarse, are addressed in this standard. Coarse grout differs from fine grout in that, in addition to sand, it contains coarse aggregates such as pea gravel. Grout may be specified by proportions or by strength requirements. Specification by proportions is recommended for grout used in brickwork. Volumes of materials used in grout specified by proportions should be consistently measured throughout the project.

Specification for Masonry Structures [Ref. 9] contains requirements for the maximum height of grout pour, the minimum width of grout space and the minimum dimensions of cells receiving grout for each grout type. Fine grout requires a minimum grout space width of ¾ in. (19.1 mm) and any cells receiving grout to be a minimum dimension of 1½ x 2 in. (38 x 51 mm). Coarse grout requires a minimum grout space width of 1½ in. (38 mm) and any cells receiving grout to be a minimum dimension of 1½ x 3 in. (38 x 76 mm).

BRICK/MORTAR COMPATIBILITY

When water passes through brick masonry walls, it does so through separations that form between the brick and the mortar at the time of laying or through cracks that form after the mortar has cured. The dominant property affecting the amount of water entering brickwork from a materials selection standpoint is the extent of bond between the brick and the mortar. Extent of bond is a measure of the area of contact at the interface between brick and mortar surfaces.

Not to be confused with extent of bond, bond strength is a measure of the adhesion between brick and mortar. Bond strength is one factor that determines if cracks form after the mortar cures. Brick and mortar combinations that have high bond strengths may not have an extent of bond that would provide high resistance to water penetration. Consequently, extent of bond is more important to water penetration resistance of brick masonry than bond strength.

Extent of bond is influenced by both brick and mortar properties and is best achieved when both are considered. Initial rate of absorption is the key property of the brick related to brick/mortar compatibility. Mortar properties include water retention, air content and workability.

The initial rate of absorption (IRA) of a brick is a measure of the amount of water taken into a 30 in.^{2} (194 cm^2) brick surface area within one minute. A brick's IRA can be measured in the laboratory under controlled drying conditions or in the field. The field IRA of a brick will vary depending on its moisture condition at the time it is measured.

Tests over the years have shown that the most complete bond is achieved when the initial rate of absorption (IRA) of a brick, at the time of laying, is below 30 g/min•30 in.^{2} (30 g/min•194 cm^2). As a result, *Specification for Masonry Structures* requires brick with initial rates of absorption in excess of this value to be wetted prior to laying. Water penetration tests of masonry built with low and high IRA brick [Ref. 4 and 5] indicate that water penetration generally increases as brick IRA increases and as mortar water retention decreases. Thus, low IRA brick should be combined with mortars that exhibit low water retention and high IRA brick should be combined with mortars with high water retention, See *Technical Note* 8B for mortar recommendations with brick of various IRAs.

Mortar air content will also affect extent of bond. Higher air content mortars such as masonry cement mortars and those made with air-entrained cements or lime are more likely to increase water penetration.

Several studies have shown that workmanship is critical with respect to water penetration. Thus, mortars with better workability should be used. There are no recognized tests to determine mortar workability, but it typically increases with air content and lower compressive strength mortars.

TIES AND ANCHORS

Ties and anchors in a masonry wall system connect two or more wythes together or attach the brick veneer to a structural backing. Ties and anchors do not directly influence water penetration, except when related to cracking of the brickwork and resulting water entry. All ties and anchors must be corrosion-resistant. Applicable ASTM standards for corrosion-resistance of masonry ties and anchors are discussed later in this *Technical Note*. More detailed information on ties and anchors can be found in *Technical Note* 44B.

Truss-type joint reinforcement that engages the brick wythe with fixed diagonal cross wires is only permitted in multiwythe walls with a filled collar joint. In other walls, it can restrict differential in-plane movement between masonry wythes, which can lead to cracking and subsequent water penetration.

Additional Considerations

Drips. A drip is a bend or crimp in a tie or anchor that helps any moisture traveling across the tie to drip off before reaching the interior masonry wythe or backing. Ties and anchors with drips are not permitted [Ref. 6] because the drips reduce the compressive and tensile capacity of the ties when transferring the lateral loads between the wythes.

Corrosion Resistance. Corrosion resistance is usually provided by zinc coatings or by using stainless steel. The level of corrosion protection required for wall ties and anchors varies with their intended exposure conditions, as follows [Ref. 6]:

- when exposed to earth or weather or to a mean relative humidity exceeding 75%, ties and anchors are required to be stainless steel, hot-dip galvanized or epoxy-coated
- in other exposures, ties and anchors must be mill galvanized, hot-dip galvanized or stainless steel.

In addition, the designer should consider the potential for corrosion due to contact between dissimilar metals.

Items protected by zinc coatings may be hot-dip or mill galvanized. With mill galvanizing, the steel is galvanized before the joint reinforcement or wall tie is fabricated. Therefore, ends cut during or after the manufacturing process are not coated. With hot-dip galvanizing, the finished item is galvanized, providing more complete coverage. Stainless steel items should be AISI Type 304 or Type 316 and conform to the appropriate specification listed below. *Building Code Requirements for Masonry Structures*, also known as the MSJC Code [Ref. 6] also allows epoxy coatings to be used as corrosion protection.

To ensure adequate resistance to corrosion, coatings or materials should conform to the following:

Zinc Coatings - ASTM A 123 or A 153 Class B (for sheet metal ties and sheet metal anchors) or 1.50 oz/ft^2 (458 g/m^2) (for joint reinforcement, wire ties and wire anchors)

ASTM A 641, 0.1 oz/ft^2 (0.031 kg/m^2) (minimum for joint reinforcement)

ASTM A 653, Coating designation G60 (for sheet metal ties and sheet metal anchors)

Stainless Steel - ASTM A 240 (for sheet metal anchors and sheet metal ties)

ASTM A 480 (for sheet metal anchors and sheet metal ties and for plate and bent-bar anchors)

ASTM A 580 (for joint reinforcement, wire anchors and wire ties)

ASTM A 666 (for plate and bent-bar anchors)

Epoxy Coatings - ASTM A 884 Class A, Type 1- less than or equal to 7 mils (175 μm) (for joint reinforcement)

ASTM A 899, Class C – 20 mils (508 μm) (for wire ties and wire anchors)

MASONRY HEADERS

A header is a masonry unit laid perpendicular to the wythe that may be used to connect two wythes of masonry. Although the MSJC Code allows wythes of masonry designed for composite action to be bonded by masonry headers, they are not commonly used in contemporary construction. These units provide a direct path for water penetration from the outside of the wall to the interior along the head and bed joints. As a result, they are not recommended.

WATER-RESISTANT BARRIERS

Water-resistant barriers are membranes placed behind claddings as a secondary measure to prevent the passage of liquid water to underlying materials such as sheathing and other wall elements susceptible to moisture damage. This function is distinct from those provided by vapor retarders, intended to prevent water vapor diffusion, and air barriers, intended to prevent air flow through the wall system. However, some materials can serve all three functions. A water-resistant barrier should keep out any water which finds its way across the air space via anchors, mortar bridging or splashing.

A water-resistant barrier is required in exterior walls when brick veneer is anchored to wood or steel framing and can be provided by No. 15 asphalt felt or other approved materials as described below. While a membrane is preferred, sheathing or rigid insulation boards with an inherent resistance to moisture penetration may serve as the water-resistant barrier when all edges and joints are completely taped or sealed.

Sheet Membranes

Typically, mechanically attached membranes should not be left exposed to UV light for an extended period of time, as they deteriorate and become less water-resistant.

Asphalt Saturated Felt. One layer of No. 15 asphalt felt is prescribed by most codes as the material for water-resistant barriers. The felt should conform to Type I of ASTM D 226, Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing. The durability of asphalt-saturated felt is adequate; however it may be torn during or after installation. Asphalt-saturated felt typically has a high water vapor permeability.

Building Paper. Asphalt saturated kraft paper (generally referred to as building paper) has a long history as an approved and common substitution for No. 15 asphalt felt. Building paper for use as a water-resistant barrier should conform to the requirements of Federal Specification UU-B-790a, Type I, Grade D. Characteristics of building paper are similar to those of asphalt saturated felt. Building paper typically has less asphalt and lower permeance than felts and can offer better resistance to bending damage.

Polymeric Films. Some plastic films (building-wraps) have been approved for use as water-resistant barriers. These films may have qualities similar to those of other water-resistant barriers, but ascertaining the effectiveness of a particular plastic as a water-resistant barrier can be difficult as a standard specification is yet to be developed. Some plastic membranes act as vapor retarders and can potentially trap water vapor inside the stud wall where it can condense if the temperature in the wall drops below the dew point. Thus, all plastic membranes should not be considered suitable and caution should be exercised when specifying them as water-resistant barriers. AC38, Acceptance Criteria for Water-Resistive Barriers [Ref. 1], developed by the International Code Council Evaluation Service, Inc., is typically used to establish the suitability of a polymeric film as a water-resistant barrier. Perforated films are not recommended because they do not consistently resist water penetration in commonly used performance tests. PVC is not recommended because of its tendency to become brittle with age.

Polymeric films are highly resistant to tearing and often function concurrently as air barriers; however, they do not tend to seal themselves when penetrated by fasteners as felts sometimes do. Some manufacturers suggest fasteners with large heads or plastic caps be used rather than standard fasteners to enhance water penetration resistance at fastener locations. Polymeric films can often be installed with fewer lap joints than felt and building paper, as they are supplied in larger rolls up to 10 feet (3.1 m) wide.

Liquid Applied Films

Liquid applied films often have the capability of serving as vapor and air barriers and sometimes thermal insulation, in addition to providing water resistance. These coatings are varied in type and may be spray, roller or trowel applied; however they generally have the benefit of providing a seamless, monolithic membrane that adheres to most substrates. Although these materials can be applied rapidly, they require skilled applicators to ensure quality and performance.

These membranes have a unique set of service requirements as a result of being bonded to a substrate. The effects of wet substrates, expansion and contraction at substrate joints, volume changes of building materials, and stresses caused by lateral loads must be considered so that the membrane performs successfully during its life. Quality installations are more difficult to achieve on substrates with rough surfaces and may require increased thicknesses.

Board Products

Sheathings and other board products that are inherently water-resistant or have water-resistant facings are permitted to serve as water-resistant barriers when the edges and joints of boards are completely taped or sealed. To perform successfully, the materials providing this seal must maintain their integrity and performance when subjected to moisture and other environmental conditions for the entire service life of the wall. Board products that act as water-resistant barriers should be vapor permeable except when they are also intended to serve as a vapor retarder.

SHELF ANGLES AND LINTELS

Although similar, shelf angles and lintels differ in the way each is incorporated into brickwork. A shelf angle supports brick veneer and is anchored to the structure. A lintel, on the other hand, is a structural beam placed over an opening to carry superimposed loads. As such, it is supported by the masonry on each side of the opening and is not attached to the structure.

Lintels may be loose steel angles, stone, precast concrete or reinforced masonry. The proper specification of material for lintels is important for both structural and serviceability requirements.

Nongalvanized and non-stainless steel angles and lintels should be primed and painted as a minimum to inhibit corrosion. For severe climates and exposures, such as coastal areas, consideration should be given to the use of galvanized or stainless steel shelf angles and lintels. Even where galvanized or stainless steel shelf angles and lintels are used, continuous flashing should be installed to protect the angle. To ensure adequate resistance to corrosion, shelf angles should be protected by a zinc coating conforming to ASTM A 123, or be made of stainless steel conforming to ASTM A 167, Type 304. Additional discussion and details of shelf angles and lintels may be found in *Technical Notes* 21, 21A, 28B, 31 and 31B.

FLASHING

Selection of a proper flashing material is of utmost importance because the flashing is a critical element to the drainage of water that may penetrate the wall system. Flashing materials should be waterproof, durable and resist puncture and cracking during and after construction. Because flashing may be installed in advance of the exterior brick wythe, it should be able to endure some exposure to ultraviolet (UV) light without significant deterioration. The flashing should also resist damage from contact with metal, mortar or water and be compatible with adjacent adhesives and sealants. Minimum recommended flashing thicknesses are included below for each type of flashing. In general, thicker flashings are more durable, but may be more difficult to form.

Flashing materials generally fall into three categories: sheet metals, composite materials (combination flashings) and plastic or rubber compounds. The selection is largely determined by cost and suitability. It is suggested that only superior quality materials be selected, since replacement in the event of failure may be expensive. Materials such as polyethylene sheeting, asphalt-impregnated building felt, building paper and house wraps should not be used as flashing materials. These materials are easily damaged during installation and in many cases, turn brittle and decay over time.

Sheet Metals

Stainless Steel. Stainless steel is an excellent flashing material that has excellent chemical resistance and does not stain masonry. Stainless steel flashing should conform to ASTM A 167, Type 304. The minimum thickness should be at least 0.01 in. (0.25 mm).

Because it is difficult to form, preformed shapes are commonly used, although these are difficult to bend on-site if field adjustments are required. Mastic can be used to seal joints between individual flashing pieces, as stainless steel can be difficult to solder.

Copper. Copper is another excellent flashing material that is durable, easy to form and solder, and is available in preformed shapes. Exposed copper may stain adjacent masonry, but it is not damaged by the caustic alkalies present in masonry mortars. It can be safely embedded in fresh mortar and will not deteriorate in continuously saturated, hardened mortar, unless excessive chlorides are present. When using copper flashing, prohibit the use of mortar admixtures containing even small amounts of chloride ions.

Copper flashing should conform to ASTM B 370, Standard Specification for Copper Sheet and Strip for Building Construction, or B 882, Specification for Pre-Patinated Copper for Architectural Applications. The Copper Development Association recommends minimum weights of 12 oz./ft^2 and 16 oz./ft^2 for “High Yield” and standard cold rolled copper, respectively, used as through-wall flashing. If copper flashing is used adjacent to other metals, proper care should be taken to account for separation of the materials. Laminated copper flashing and combinations of copper sheet and other materials are discussed below in the Composites section.

Galvanized Steel and Zinc Alloys. Galvanized coatings are subject to corrosion in fresh mortar, thus the use of galvanized steel as through wall flashing is not recommended. Although corrosion forms a very compact film around zinc, its extent cannot be accurately predicted. Bending steel items cracks the galvanized coating, thereby reducing its durability. Some zinc-alloy flashings are available, but, like many alloys, these may have properties considerably different from those of the pure metal.

Aluminum. Aluminum should not be used as a flashing material in brick masonry. The caustic alkalies in fresh, unhardened mortar will attack aluminum. Although dry, seasoned mortar will not affect aluminum, corrosion can continue if the adjacent mortar becomes wet.

Sheet Leads. Thin lead sheet is not recommended as a flashing material in brick masonry. Lead, like aluminum, is susceptible to corrosion in fresh mortar. Furthermore, where lead is partially embedded in mortar with moisture present, galvanic action can occur resulting in the gradual disintegration of the lead.

Plastic and Rubber Flashing

Plastic and rubber flashings are resilient, corrosion resistant materials that are easy to form and join. However, because the chemical compositions of these products vary widely, the durability of these materials is variable. Thus, it is necessary to rely on performance records of the material, the reputation of the manufacturer, and where possible, test data to ensure satisfactory performance. Some of the critical areas are: (1) resistance to degradation in UV light; (2) compatibility with alkaline masonry mortars; (3) compatibility with joint sealants and (4) resistance to tear and puncture during construction. A minimum thickness of 30 mil (0.76 mm) is recommended for plastic and rubber flashings.

Polyvinyl chloride (PVC). PVC degrades under exposure to UV light and should be cut flush with the face of the wall or used with a metal drip edge to extend beyond the wall face.

Ethylene Propylene Diene Monomer (EPDM). EPDM is a synthetic rubber that is used as a single ply roofing membrane as well as flashing. It has better low temperature performance the PVC, and better weathering resistance than butyl rubber. It is commonly available in a thickness of 40 mils (1.0 mm) or greater, reducing concerns of fragility during construction. Dimensional stability may be a concern.

Self-Adhesive Rubberized Asphalt. Self-adhesive rubberized asphalt flashing adheres to other building materials and itself, thus speeding flashing installation and making it easier to seal flashing laps and terminations. These flashings are also self-healing, making them less susceptible to small punctures. Substrates should be dry and clean for proper adhesion. In addition, when self-adhesive flashings are used, care should be taken to ensure compatibility between the flashing adhesive and sealants used in the wall. Primers may be necessary to ensure adequate adhesion of self-adhering flashings to some substrates.

Composites

The most common type of composite or combination flashing is a thin layer of metal sandwiched between one or two layers of another material, such as bitumen, kraft paper or various fabrics. The metal layer is usually copper, lead or aluminum. Composite flashings utilize the better properties of each of their component materials. In the case of lead and aluminum composite flashings, the paper and fabric laminates reduce the potential for corrosion resulting from the metal foil contacting the mortar or adjacent dissimilar metals. These flashings also allow the use of thinner metal sheet, making them less expensive and easier to form, but also more prone to tearing and punctures. The laminate must either be durable and stable under UV exposure or these flashings should be used with stainless steel drip edges. It is beyond the scope of this *Technical Note* to describe the various types of composite flashing and their properties. The manufacturer's literature should be consulted for the various types of composite flashing available.

DRAINAGE MATERIALS AND MORTAR DIVERTERS

When a high probability of mortar falling into the air space exists, such as for tall brick veneer without shelf angles, drainage materials and mortar diverters may be useful to help prevent mortar from bridging the air space or blocking weeps. It is beyond the scope of this *Technical Note* to characterize the widely varying types of materials used for these purposes. Manufacturers' literature should be used to compare and determine the suitability of drainage materials and mortar diverters. The use of drainage materials should not preclude good workmanship and an effort to keep the air space clean of excess mortar droppings.

WEEPS

Although open head joint weeps are the recommended type of weep, some weeps are made using plastic or metal tubes, or using rope wicks. These alternate weeps should be spaced more closely as they do not drain water as quickly. Weep openings are permitted by most building codes to have a minimum diameter of $^{3}/_{16}$ in (4.8 mm). Rope wicks should be at least 16 in. (406 mm) long and made from cotton sash cord or other materials that wick. Items used to form weeps should not easily deteriorate or stain the brickwork. Open head joint weeps may have non-corrosive plastic, mesh or metal screens installed if desired. Vent-type weeps can serve a dual function of allowing water to drain, but can also allow air to enter the cavity resulting in more drying action. There is no single method that produces the best weep for all situations.

SEALANTS

Sealants are an important element in preventing water penetration around openings in masonry walls. Too frequently, sealants are relied on as a means of correcting or hiding poor workmanship rather than as an integral part of construction.

A discussion of the characteristics of joint sealants is beyond the scope of this *Technical Note*, but a few comments are in order. Sealants should be selected for their durability, extensibility, compressibility and their compatibility with other materials. Other important considerations in sealant selection may include curing time, UV resistance, color stability, resistance to staining and the ability to handle a broad range of joint sizes. A sealant should be able to maintain these qualities under the temperature extremes of the climate in which the building is located. Trial applications of sealants under consideration are always helpful in determining suitability for a particular application. Additional discussion of sealants may be found in *Technical Notes* 18 and 18A.

Oil-based caulks and acetoxic silicone sealants that attack cement in mortar should not be applied to masonry. Solvent-based acrylic sealant or a butyl caulk should only be used where little or no movement is expected, such as joints around windows and other openings. For joints subject to large movements, such as expansion joints, an elastomeric joint sealant conforming to the requirements of ASTM C 920 should be used. This includes silicones, urethanes and polysulfides. Application of a sealant primer may be required to preclude staining of some sealants on certain brick.

Backer rods are recommended behind sealants in joints large enough to accommodate them. Backer rods should be plastic foam or sponge rubber. Backer rods should be capable of resisting permanent deformation before and during sealant application, non-absorbent to liquid water and gas, and should not emit gas which may cause bubbling of the sealant. A bond breaking tape may be used when there is not sufficient space for a backer rod. For further information on sealants, refer to ASTM C 1193, Guide for Use of Joint Sealants.

COATINGS

The use of external coatings, such as paint or clear coatings, on brick masonry should be considered only after a detailed evaluation of the possible consequences. Although coatings are not required on properly designed, specified and constructed brick masonry, they may be used successfully to correct certain deficiencies or alter the wall's appearance.

Coatings intended to reduce water penetration (water repellents) are most effective when their intended use corresponds with the nature of the water penetration problem. Use of coatings for reasons outside their intended application rarely reduces water penetration and often leads to more serious problems. Considerations in the choice of coating include: compatibility with brick masonry, water and air permeability, ability to span cracks, applicability to exterior exposure, potential lifespan and aesthetic considerations. *Technical Notes* 6 and 6A should be consulted when considering a coating for brick masonry.

SUMMARY

This, the second in a series of *Technical Notes* on water resistance of brick masonry, has provided information on properly selecting quality materials for masonry work. This *Technical Note* cannot cover all available materials or all conditions. Lack of specific reference to a material should not preclude its use providing that it results in water-resistant brick masonry.

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