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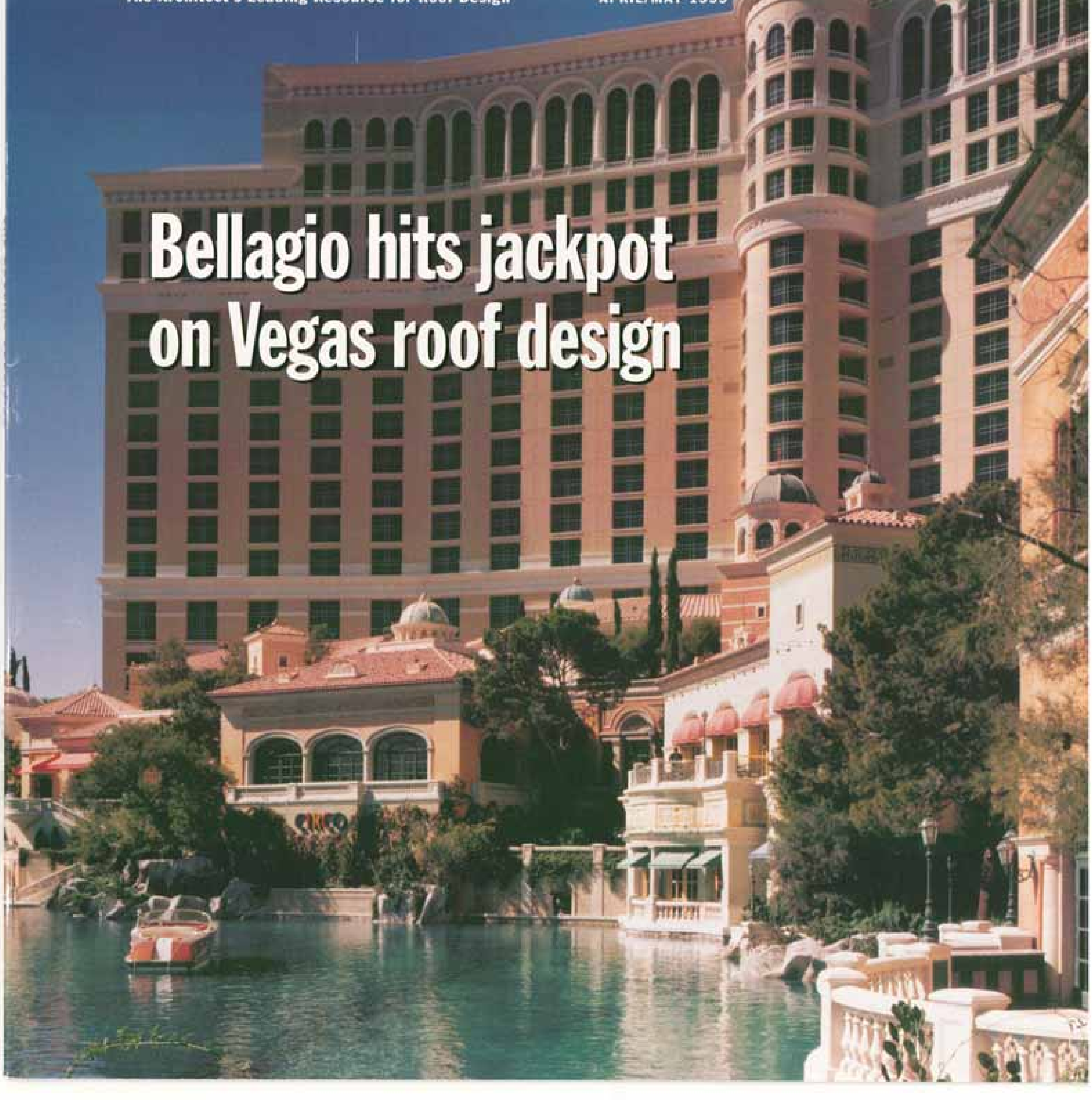

Bellagio hits jackpot on Vegas roof design

Sealant specs that work

Want to be a roof sealant expert? Put these tips to the test

Masked joint: *Sealant bead prior to creating cap bead, "band aid" profile.*

Elastomeric sealants are used throughout the roof system assembly, typically in conjunction with sheet metal fabrications. However, a wide variety of sealants are commercially available and each type has specific performance characteristics that specifiers need to be aware of.

The most common sealant types currently used in roofing installations include silicone, polyurethane and butyl. Common locations for sealant applications in roofing include caulk troughs of surface mounted counterflashings/termination bars, penetration bonnets, lap joints in sheet metal fabrications (i.e. counterflashings, copings, etc.), pitch pan filler and in-seam sealer in standing seam metal panels.

There are several precautions, technical criteria and installation scenarios that require proper attention in order to achieve the desired performance of the specific sealant.

Getting a bead on sealants

The optimum joint profile for elastomeric sealants, as published by the sealant industry, consists of an hourglass-shaped configuration applied between two parallel planes. The size (width and depth) of the sealant joint depends on several variables, with a general rule of thumb of a width-to-depth ratio of 2:1.

Sealant in *caulk trough, located at bonnet of penetrating flashing*

There are four basic rules that cover basic sealant joint dimensioning:

1) The minimum joint size should be 1/4-inch x 1/4-inch

2) For joint widths of 1/4-inch to 1/2-inch, the depth should equal to the width

3) For joint widths of 1/2-inch to 1-inch, the depth should be 3/8-inch to 1/2-inch

4) For widths from 1-inch to 4-inches and up, the depth may be 1/2-inch to 3/4-inch, depending on width, application and sealant type.

Actual joint sizing requires calculation of the different types of movement and allowable tolerances. The typical installations of sealants in roofing consist of the material applied in either fillet shaped profiles, "cap" bead profiles, sandwiched between "plates," or in the optimum hourglass configuration.

The fillet profile commonly occurs in the caulk troughs of surface-mounted counterflashings or termination bars (T-bars). The trough is formed as the top edge of the metal counterflashing or T-bar is bent outward at an angle of approximately 30 degrees with the vertical substrate (see Figure 1). The length of the trough is typically approximately 1/4 to1/2 inch.

When installing sealant in a trough, a sufficient quantity of sealant should be gunned into the trough to allow proper tooling of the sealant and to achieve a "canted" profile. If the sealant is of insufficient quantity and cannot be tooled, than proper bonding to the substrates will not be achieved. A finished canted profile will provide a surface that is sloped away from the vertical wall and will shed water away from the potentially vulnerable sealant bond interface.

A backer rod can be inserted into the trough to minimize the depth of the sealant and to provide a back-up substrate to tool against. A minimum 1/4-inch wide surface area or "bite" on both the wall and trough should be obtained for each end of the sealant to achieve proper bond. The substrates to receive the sealant should be properly cleaned prior to application.

Bituminous or other adhesive types from installation of the roof flashings often contaminate the wall in the area to receive the sealant. Most sealants, particularly those discussed herein are not compatible with bitumen and other adhesives and will often degrade or disbond in the affected areas (see Photo 3).

In addition, the sheet metal used to fabricate the counterflashing may have oily residues or films on the surface, particularly galvanized metal. This film could act as a bond breaker and prevent proper bonding of the sealant. Cleaning the contaminated substrates by solvent wiping or an abrading type of method may be necessary to achieve a proper surface to receive sealant.

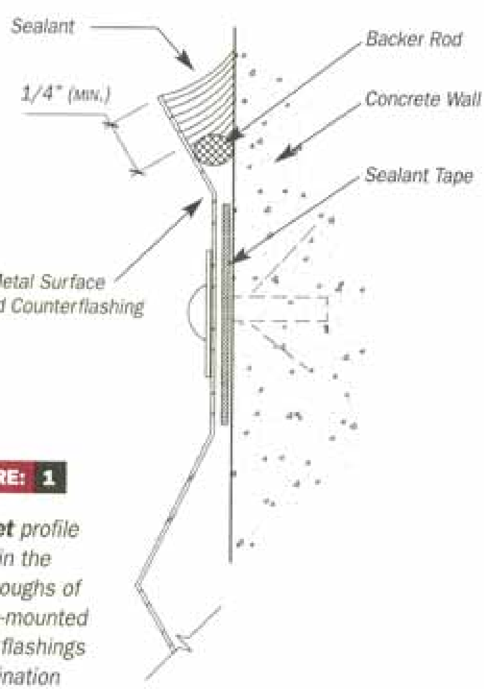

FIGURE: 1

***The fillet** profile occurs in the caulk troughs of surface-mounted counterflashings or termination bars (T-bars). The trough is formed as the top edge of the metal counterflashing or T-bar is bent outward at an angle of approximately 30 degrees.*

The cap bead profile, often referred to as "Band-aid joint," is commonly applied over the exposed leading edge of sheet metal in a lapped configuration, such as a coping cap flashing (see Figure 2). Although this joint type does not meet the optimum joint profile, similar installation techniques and methods apply.

Since the sealant is applied over what is classified as a moving joint, a bond breaker or bond preventative tape (1/4-1/2 inch wide polyethylene strip) should be placed directly over the subject edge/joint to provide a slip joint. The sealant should be gunned over the taped joint in sufficient quantity to achieve 1/4-inch (min.) wide attachment points on each side of the joint and a 1/8 to 1/4-inch sealant bead thickness. The sealant should be tooled to form a convex shaped or cap profile.

It is recommended that masking tape be applied on the substrate (metal) surface prior to the sealant application, to provide demarcation for the outer edge of the joint and to create a clean, straight finished edge. Cap beads of sealant are also commonly applied over the heads of exposed fasteners and riveted non-moving joints. In these application scenarios, bond breaker tapes are typically not required or used.

Pedal to the metal

Sealant is commonly sandwiched between two sheet metal surfaces, such as lap joints in counterflashings and copings. The sealant is typically gunned in a continuous bead onto the base metal layer and then the overlapping piece of metal is pressed into place. This lapping sequence will compress the sealant and spread the bead into a thin layer of sealant.

Although this joint type resembles the arch typical profile, the movement or forces transmitted on the sealant are shear in nature, in-lieu of compression and tension as experienced by the arch typical profile.

Sealants typically have poor shear strength qualities when the sealant is reduced to a thin film. One method that could aid in achieving better performance involves the inclusion of spacers within the joint that would prevent metal-to-metal contact and result in a sealant with a uniform cross-section.

At least one supplier, Butler Manufacturing Co., Kansas City, MO, provides both its gun-grade and tape version of butyl sealant with small pieces of nylon dispersed throughout the sealant matrix for the installation in their metal panel roof systems.

These pieces of nylon function as a spacer and allow the sealant to be compressed to a known thickness and prevent the sealant from being squeezed out of the joint.

Using a preformed sealant tape—with a relatively higher density than gun-grade versions of sealant—within lap joints can also reduce the chances of the detrimental squeezing of the sealant from the joint.

In using pre-formed sealant tapes, several precautions are urged. As with all sealants, the mating surfaces of the adjoining metal surfaces should be properly cleaned. These type of sealant tapes are double-sided/self-adhering and come in a roll with a release paper backing to prevent the material from bonding to itself. During the installation of these products, contamination of the adhesive surface by human touch should be minimized as the oils and dirt from the skin will reduce the bonding capabilities.

Upon removal of the release paper, the mating surfaces should

Pourable filler *in pitch pan.*

be adjoined immediately to prevent wind blown moisture, dust, dirt or other contamination from affecting the bond. After the plates are adjoined, they should be maintained in a uniform compression. If the metal surfaces separate from, or are not in contact with, the sealant tape, contamination and subsequently improper bond is likely.

Sealants are also commonly used in side and end lap seams in metal panel roof systems. Hot melt factory applied sealants are typically used by the manufacturer within the standing seam and are part of the panel manufacturing process. These sealants are typically either a butyl or polyisobutyl based materials. In field formed lap seams, either a gun-grade or pre-formed tape sealants or a combination of both are typically applied to seal the seam.

Problems with pitch pans

Sealants are used to fill or seal pitch pans that are installed around penetrations through roof systems. These metal pans are typically four inches in height above the roof surface and are stripped into the roof membrane with flashing membrane or plies (see Photo 2).

A cementitious non-shrink grout is typically installed into the bottom of the pan to provide a base for the filler to be applied and to reduce the quantity of elastic filler material to be applied within the pan. The grout is typically installed to approximately three-quarters of the total height of the pan or within one inch from the top of the pan. The remaining depth of the pan is then filled with the filler/sealant material.

These products are commonly two-part polyurethane compounds that are of a pourable, self-leveling consistency. The two components, Part A & Part B, have to be properly blended in order to achieve the desired compound. If the filler is not properly blended, then the compound will not cure properly and will most likely remain in a tacky, non-elastic state and not provide the intended purpose.

During the installation of roof systems, primarily bituminous based membranes, penetrations in the roof are often "temporarily" sealed with plastic roof cement until the pitch pan is installed. Even after the pitch pan is installed, plastic cement is often placed within the pan as a temporary waterproofing method until the grout and pourable sealer are brought to the jobsite.

These practices create two problems: 1) the plastic roof cement contaminates the surfaces to which the sealer will bond and is difficult to clean and 2) the plastic roof cement is incompatible with the sealer and, if not removed, will have an adverse affect of the sealer.

Sealants Compared

Silicone

Pros: 20-year warranty; little degradation over the life of the product.

Cons: Difficult bonding to certain substrates; staining can be a problem; substrate compatibility tests can be laborious.

Polyurethane

Pros: Multi-purpose; can readily bond to concrete, masonry or metal.

Cons: Weathering will result in deterioration (crazing, hardening); service life of only seven to 10 years.

Butyl-based

Pros: Good adhesion to most substrates; non-hardening cure; left unexposed, the product will remain elastic for 20+ years.

Cons: Direct exposure to the elements will result in rapid deterioration.

In addition, during the mopping process of bituminous roof applications the pan and/or the penetrating element will often become covered with bitumen deposits. Steel pipe penetrations such as equipment support structures and gas/electrical piping, particularly in reroofing applications, are commonly covered with multiple layers of paint and/or rust. Bituminous deposits together with other surface contaminants (i.e., paint, corrosion (scale), etc.) should be properly removed to achieve a sound, clean substrate to receive the pourable sealant.

Saw-cut reglets

The optimum joint profile can be encountered in roof installations at either saw-cut reglets for counterflashings or at joints between coping stones atop a parapet wall. When a reglet is saw-cut into a wall, whether masonry or concrete, proper sizing, preparation and installation are essential (see Figure 3).

The saw-cut reglet should be cut to the proper depth and width to accommodate the installation of not only the sheet metal flashing but also the sealant. The joint depth should be approximately 1 inch and the width should be 1/2-inch. After saw-cutting, the cementitious debris (mortar/masonry/concrete dust or fines) should be removed from within the joint, preferably by air blown methods.

After the sheet metal counterflashing is installed and secured in place, a backer rod should be inserted into the joint for proper sealant dimensioning and profile shaping. The sealant should be gunned into the joint and then tooled to achieve a concave, downward and outwardly sloping finished face that will promote shedding water away from the wall. It is recommended by many in the sealant industry that porous surfaces such as masonry should be primed prior to application of sealant in order to achieve the optimum bond.

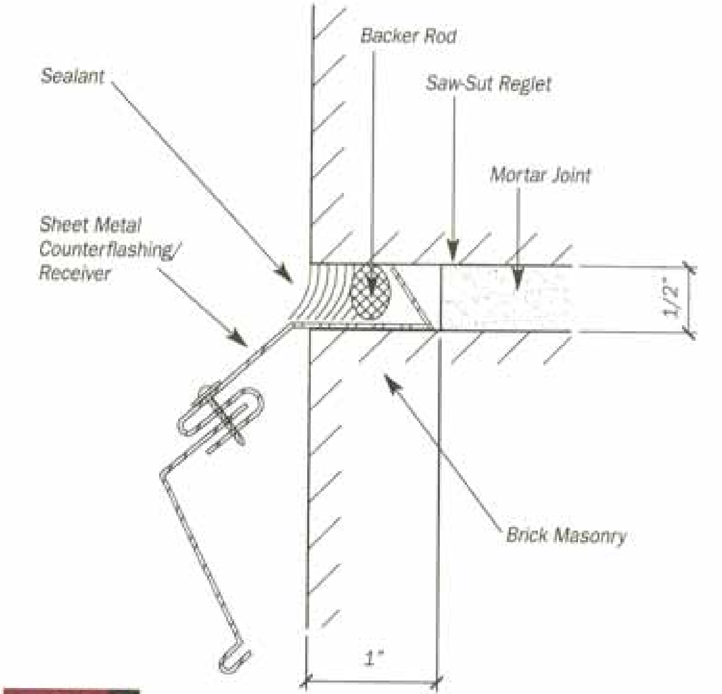

FIGURE: 3

The saw-cut reglet should be cut to the proper depth and width to accommodate the installation of not only the sheet metal flashing but also the sealant. The joint depth should be approximately 1 inch and the width should be 1/2-inch.

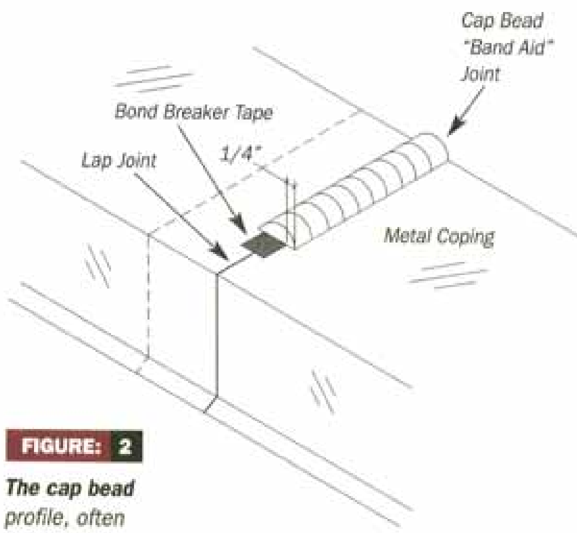

FIGURE: 2

***The cap bead** profile, often referred to as a "Band-aid joint." Although this joint type does not meet the optimum joint profile, similar installation techniques and methods apply.*

The head joints located between the ends of adjacent cementitious coping stones often require attention during the roof renovation project. This joint, in existing conditions, will be filled with either mortar or sealant. Existing materials located within the joint should be removed to a depth to achieve the desired sealant joint profile.

The author recommends that the head joints be sealed with sealant in-lieu of mortar, as separation cracks are likely to occur between the mortar and stone at the bond interface. Therefore, it is recommended that the mortar should be removed only to the proper depth to install the new sealant. This scenario creates a double joint filler, with the sealant being the primary/initial seal and the underlying mortar the secondary seal or filler.

One option that would minimize the amount of mortar removal, is to use a bond breaker tape, in-lieu of backer rod, to be placed against the mortar prior to placement of the sealant. Using a maximum sealant joint profile of 1/2-inch, the mortar only has to be removed to that depth. The bond breaker tape will prevent three-side adhesion of the sealant.

The cementitious faces to receive sealant should be cleaned and primed. It is recommended that the horizontal top surfaces of the stone adjacent to the subject joint should be masked with tape to prevent possible soiling and/or staining from either the primer or the sealant).

In addition, masking of the joints will result in clean, straight finished edges of the sealant joint. The sealant should then be gunned into the joint of sufficient quantity to result in a tooled flat surface that is level with the top horizontal surface of the coping stones.

Although the concave profile is the preferred face profile for sealants, a flat tooled finish will

Sealant along caulk trough is contaminated by roofing bitumen.

function appropriately and will eliminate the possibility of ponding water within the joint, particularly on non-sloping stones.

How sealants stack up

The three basic sealant types discussed herein each have particular performance/installation requirements. Silicone based sealants are made from silicone polymers, fillers, cross-linkers and other additives and are generally considered to be inorganic materials. These sealant compounds will perform satisfactorily for many years of exposure without significant degradation (hardening, shrinkage).

Silicone sealant manufacturers will commonly offer a 20 year material warranty on the sealant. However, silicone sealants have a reputation of difficulty in obtaining proper bonding to certain substrates.

Silicone sealants also have particular limitations due to potential staining of the substrate. Installation of silicone sealants often requires testing of the substrate for staining potential and an extensive, thorough and often laborious process in order to achieve a properly cleaned substrate to receive the sealant.

Polyurethane based sealants are composed of urethane polymers combined with fillers, plasticizers, solvent and other additives. These sealants have a fair resistance to exposure to weathering elements (i.e. UV, heat, moisture, etc.) that will eventually result in deterioration (crazing, hardening, etc.) of the sealant material. These sealant materials typically have an in-service life of seven to 10 years. These sealants are often considered to be a multi-purpose sealant as they have the tendency to be able to readily bond to many different substrates, particularly concrete, masonry and metal.

Butyl based sealants are composed from butyl rubber and modified with solvents and/or oils. These types of sealants typically show good adhesion to most substrates and are installed in concealed joint conditions or where non-hardening cure is desired. Direct exposure of these sealants will result in rapid deterioration. However, if a butyl sealant is retained in a concealed condition, the material will typically remain in a pliable/elastic state and retain the bonding tenacity for many years (20+).

Another consideration in using various sealant types on a project, is the possible contact between the varying sealants. Each of the sealants discussed herein are not compatible with each other. If contact of two different sealants occurs, either degradation or disbonding will likely result.

Some common reference standards for sealants include the following: ASTM C 1193 Standard Guide for Use of Joint Sealants, ASTM C 717 Standard Terminology of Building Seals and Sealants, and ASTM C 920 Standard Specification for Elastomeric Joint Sealants. References used for this article include: Joint Sealers, CSI Monograph Series, Dec. 1991, and Sealants: The Professionals Guide, SPRI, 1990.

Spec summary

Although sealants perform satisfactorily for many years and meet their intended purpose, the waterproofing and/or weathertightness of a roof assembly or related flashing details should not rely solely on the integrity of the sealant.

A roof assembly and associated details should be designed and installed so that the sealant is not the primary waterproofing element. The sealant should be either the secondary or third level of defense against water infiltration or should be the initial line of defense with underlying secondary and third levels of defense.

Sealant is often used as to "dress-up" critical waterproofing joints and is superficially applied (smeared) over improperly or poorly fitted joints and/or junctures of materials, either of the same or different composition. No matter the sealant type used, this is a recipe for disaster down the road.

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