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Exterior Sealant Joint Design

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ABSTRACT:

When sealants fail, the integrity of the entire building is in jeopardy. Calculate the size and spacing so joint sealants will accommodate the expected thermal movement. Select joint sealants that are rated to withstand the total joint movement. And test the joint sealants with the substrate to ensure proper adhesion.

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07 92 00 Joint Sealants.

KEYWORDS:

Elastomeric, Sealant, Adhesive Failure, Cohesive Failure, Thermal Expansion and Contraction, Joint Size

REFERENCES:

ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants.

ASTM C920 - Standard Specification for Elastomeric Joint Sealants

ASTM C1193 - Standard Guide for Use of Joint Sealants

The Issues

Designing, installing, and maintaining sealant joints correctly will prolong the life of any building. When joint sealants fail, the integrity of the entire building is in jeopardy. Envelope sealants are the first line of defense against air and water intrusion. Water entering the building through failed joints will cause serious damage including rot, corrosion, and mold. Air entering the building will require additional energy to maintain the interior environment.

Elastomeric sealants for general architectural use are available in two primary formulations: polyurethane and silicone. Other formulations are available for specialty applications. This article will focus on the two primary formulations to discuss joint sealant performance, joint design, and failure.

The Failures

The photo above from a recent failure investigation shows examples of both cohesive and adhesive sealant failures. Cohesive failure indicates that the sealant could not resist the stress applied when the adjacent materials contracted during cold temperatures. Adhesive failures occur at the bond line between the sealant and the joint substrate. Usually this condition is the result of inadequate joint preparation or bonding to the joint backing. When the joint substrate surfaces are not cleaned and primed properly the sealant will not adhere to the substrate.

These joint failures were the direct cause necessitating replacement of the entire exterior wall.

Sealant Materials

Exterior sealants are normally an elastomeric type. This means that the sealant material will withstand joint compression and extension due to thermal expansion and contraction of the adjacent materials. When air temperatures change the envelope materials expand or contract. Sealant joints compress or extend to compensate for the building envelope materials' movement.

ASTM C920 rates sealants by their ability to withstand movement expressed as a percent of the joint width. All elastomeric sealants will meet Class 25, meaning they will withstand 25% extension and 25% compression. Many sealants meet Class 50. Some sealants will meet Class 100/50 meaning they will withstand 100% extension and 50% compression. These Class100/50 sealants are commonly used for exterior insulation finish systems (EIFS) because their very low stress during extension will prevent damage to EIFS substrates.

ASTM C920 further classifies sealants by type, grade, and use.

- Type S - Single Component
- Type M - Multi-Component
- Grade P - Pourable or self-leveling
- Grade NS - Nonsag or gunable
- Use T - Traffic conditions
- Use NT - Non-traffic conditions
- Use I - Immersion conditions
- Use M - Mortar contact
- Use G - Glass contact
- Use A - Aluminum contact
- Use O - Other material contact

Single component sealants rely on ambient moisture to cure. So cure times are dependent on environmental conditions. Multi-component sealants are chemically cured with predictable cure times. Grade P is used for horizontal applications. Grade NS is used for other applications.

Joint Movement

The sealant joint must be designed to accommodate the full extent of movement over the entire expected temperature range. Masterspec and SPECTEXT® specify that exterior envelope assemblies must withstand a temperature range of 120 deg F.

The change in the joint dimension is directly proportional to the change in temperature, the length of the adjacent envelope material, and the coefficient of expansion for the envelope material. Use the following equation to calculate the change in dimension for envelope materials:

□L = C x L x □T where

□L = change in dimension in inches
C = coefficient of expansion in inches/inch/deg F
L = length of the envelope material
□T = temperature range in deg F

Joints must be sized to compensate for building envelope materials movement, on both sides of the joint. If the joint movement is 1/8 inch compression and 1/8 inch extension and the sealant is rated at Class 25, then the joint width must be 1/2 inch. Calculate the joint width by dividing the required movement by the percent movement capability from the sealant class rating.

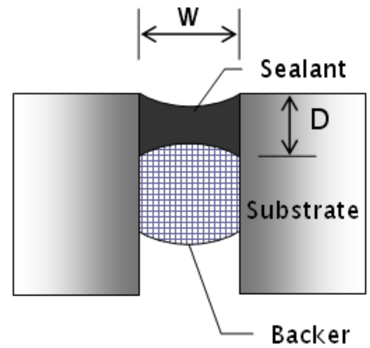
Joint Width = 1/8 in. / 0.25 = 1/2 in.

Joint Design

Proper sealant joints consist of a substrate, backer, and sealant. The substrate forms the sides of the joint and the surface to which the sealant must adhere. The backer acts as a mold to control the sealant depth and as a bond break to prevent sealant adhesion except at the sides of the joint. The sealant fills the joint between the substrates to exclude air and water from the building.

The substrate must be clean and dry before installing the sealant. Often substrate primers are required to ensure proper adhesion. Silicone sealants require primers for virtually every substrate, except glass. The need for a primer can be determined easily by preconstruction testing performed by the sealant manufacturer in accordance with ASTM C794.

Backers are installed in the joints so the depth of the sealant is 50% of the width of the joint.



Joint Depth D = 0.50 x W

Usually the maximum joint depth is 1/2 inch for silicone sealants and 3/4 inch for polyurethane sealants.

Conclusions

Calculate the size and spacing so building envelope joints will accommodate the expected thermal movement. Select joint sealants with movement capability matching the joint requirements. Conduct preconstruction testing to ensure the correct primer is selected and that sealant will adhere to the substrate. Inspect joints periodically to ensure proper, continuous performance.

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