# The Use of Structural Silicone Sealant for Film Attachment

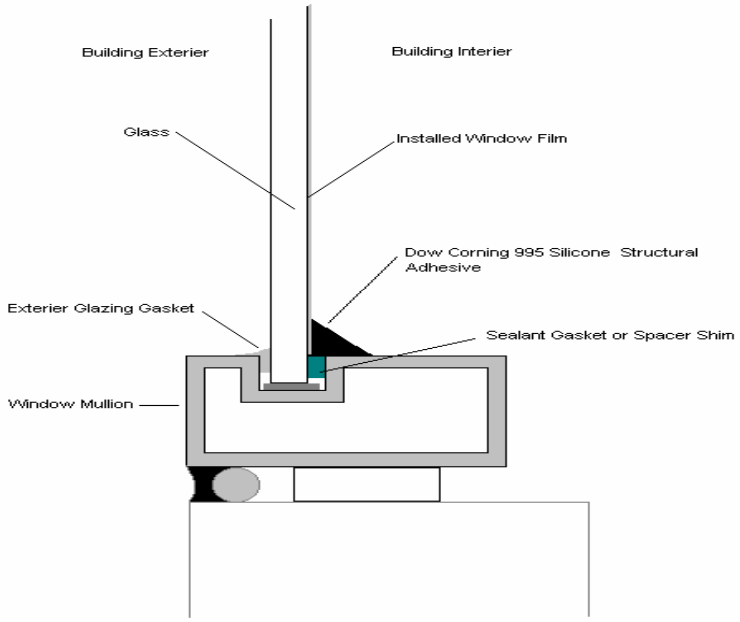
Window glass performs a vital function in buildings; however, the nature of glass creates certain hazards. These hazards include, the potential spontaneous breakage of tempered glass, flying glass that can cause injury during a severe storm like a hurricane or tornado. A bombing such as the Alfred P. Murrah Federal Building in Oklahoma City can cause glass breakage for many blocks. Broken lites falling out of buildings could harm people on the ground this could occur when a cracked piece of glass works it's way out of an opening. Other issues relating to glass are simple security concerns relating to people breaking a storefront window.

In each of these areas there are two underlying needs, first to hold the glass together keeping the shards from flying and second to keep the glass attached to the frame. These needs are met by a combination of an applied window film that holds the glass lite together preventing flying shards and an attachment system that must hold the lite into the supporting frame. Systems designed using structural silicone sealant to anchor an applied polyester film onto a supporting frame have proven to be effective techniques for protecting people from the hazards of glass when evaluated for blast or impact resistance.

Each of the applications referred to above have slightly different needs and requirements therefore any system that is used needs to be evaluated for the specific requirements and must only be used as tested. For example a system that passes a 4-psi bomb blast may not be acceptable for a hurricane application or a 10-psi blast requirement. Performance depends upon the flexibility of the entire system as well as the strength of the entire system. (Including the film, sealant and frame) Therefore the sealant joint cannot be designed without a thorough understanding of the strength and flexibility of the entire window film system. A joint that performs well with one type of window film may not perform as well with a different type of film.

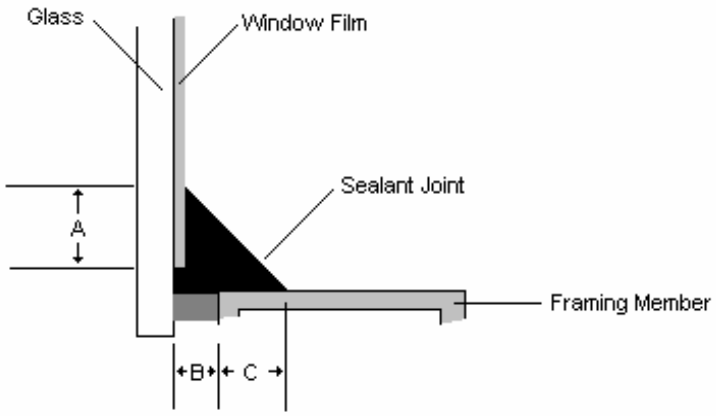
The sealant attachment systems that have proven to be economically viable are built around a triangular joint connecting the film onto the supporting framing member. To achieve acceptable performance a very high performance sealant must be used. The purpose of this tech talk is to document some of the key parameters that have been shown to be critical for the application as well as providing examples of application issues that could affect system performance.

*Figure 1*. Application utilizing a triangular bead of Structural Silicone Sealant




Looking specifically at the sealant joint geometry there are several areas that are important to consider and control. Figure 2 illustrates a triangular sealant joint.

***Figure 2.*** Most common acceptable joint design: triangular joint




A: The sealant bite onto the attached film. To assure sealant adhesion and application a minimum sealant bite of ¼ inch is required for any sealant cap beading application. Many high performance applications designed to withstand an applied force are built around a sealant bite of 3/8" to ½ ' which has proven to perform well in a wide variety of

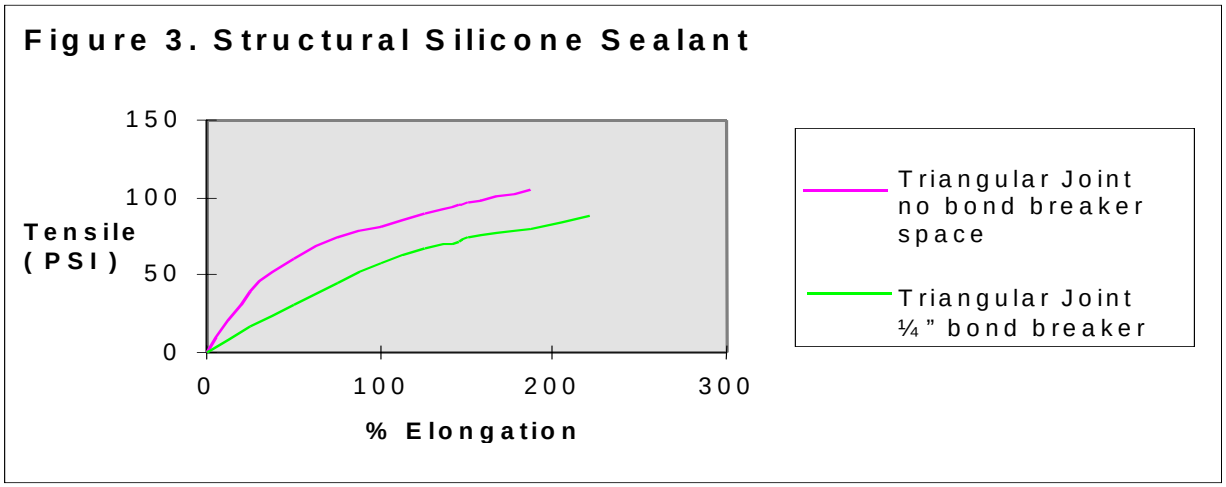
application tests. Note there is generally a slight gap (less than 1/8") between the edge of the film and the glazing channel to allow for proper installation and squeegee out of the film adhesive.

B: Gasket or glazing channel interior thickness. This is the distance between the inside of the glass to the framing member. Generally this distance is approximately ¼" depending upon the type of glazing system. This space could contain a material such as a structural silicone sealant or a firmly anchored gasket that DC 995 will adhere well to; or this space could contain a material such as a backer rod with little strength or a gasket such as Santoprene that Dow Corning 995 will not adhere to. In general the larger the distance between the glass and the first secure surface with sealant adhesion the greater the joint flexibility and lower the joint ultimate strength. (See Figure 3.)

C: Sealant bite onto the framing member. To assure sealant adhesion and application a minimum sealant bite of ¼ inch is required for any sealant cap beading application. Many high performance applications (blast resistance, hurricane resistance, etc.) designed to withstand an applied force are built around a sealant bite of up to½ ' which has proven to perform well in a wide variety of application tests.

***Figure 3.*** *A gap between the window and the mullion creates a more flexible but slightly weaker joint.*

The performance of two joints (dimension's A and C = ½" for each joint) one with a Gap of 0.0" and a second with a gap of ¼" is documented in figure 3 (pulled to failure at a rate of 2" per minute.)



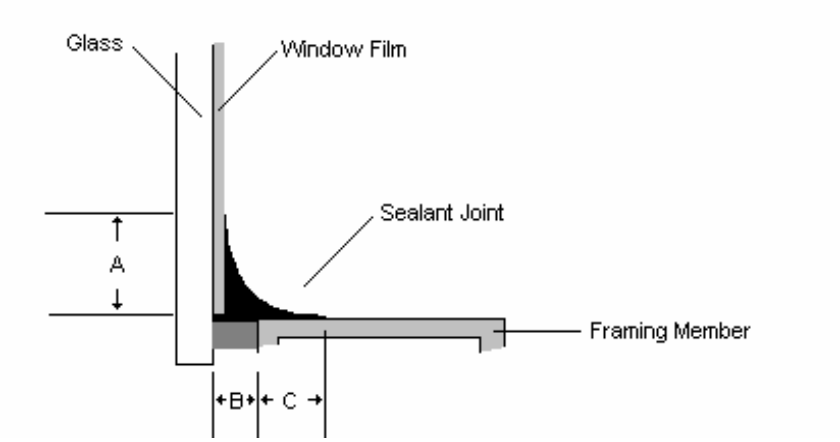

Since the requirements for any application is specific to that application it is critical to assure that the system to be installed has been tested as a whole. Generally increasing

flexibility improves performance and increasing strength improves performance therefore there is a tradeoff between strength and flexibility which must be considered by the system designer.

**Potential areas of concern**

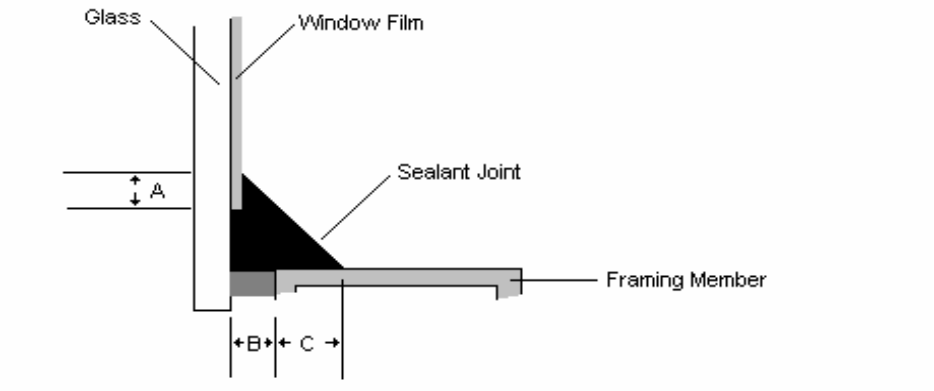
There are several areas of concern relating to the way that a triangular joint could be applied resulting in reduced performance some areas of concern are as follows:

***Figure 4:*** Avoid a concave joint surface:



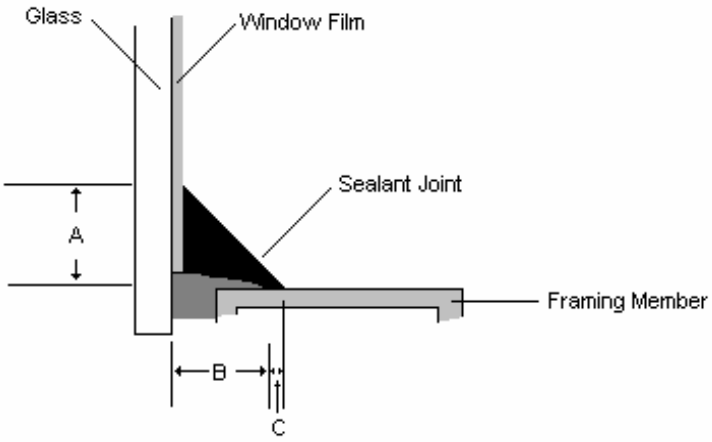

In this joint the sealant is tooled with a concave surface that would affect the strength and performance of the joint. The greater the joint concavity is the weaker the joint.

***Figure 5.*** Avoid leaving the film too short of the edge of daylight opening.



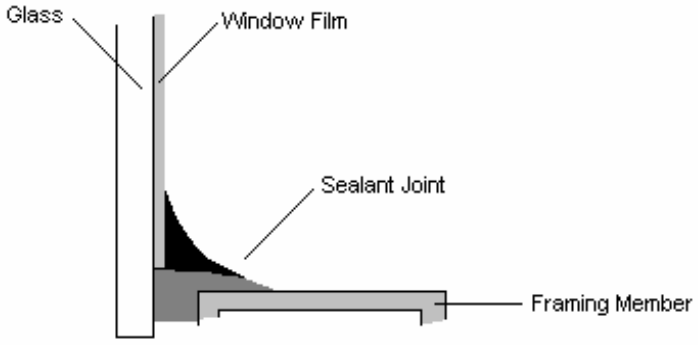
In this illustration the window film is left significantly back from the edge of the daylight opening therefore the sealant contact with the film is much less than intended for the system design and joint performance will be reduced accordingly.

***Figure 6.*** Do not install the silicone structural adhesive joint over an existing internal gasket without any cutback. This will result in a reduction of sealant bond to the framing member.




In this example the sealant adhesion onto the frame Dimension C is much less than the bond required for an acceptable sealant joint. If the sealant is bonding to the gasket the adhesion is onto a thin flap of rubber that is not designed to carry a load. As a result the joint performance will be greatly reduced.

***Figure 7:*** Do not seal directly to a gasket, and do not tool concave.



In this application the sealant is only contacting a gasket. This would be clearly unacceptable because 1) sealants often do not adhere to gasket material. 2) The gasket may not be designed to support load.

This as a general information guideline and is not a cookbook for designing joints. The sealant is only one component of a system therefore it is not a question of will the sealant work it is a question of will the system work. The system designer must evaluate the entire system.

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