

SILICONE SEALANTS AND COATINGS FOR BUILDING CONSTRUCTION AND RESTORATION

BY: DOW BUILDING SCIENCE

Course #0DOW002

- Credit(s) earned on completion of this course will be reported to AIA CES for AIA members. Certificates of Completion for both AIA members and non-AIA members are available upon request.



- This course is registered with AIA CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.

Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

COPYRIGHT MATERIALS

This presentation is protected by U.S. and international copyright laws. Reproduction, distribution, display and use of the presentation without written permission of the speaker is prohibited.

© 2006-2024 The Dow Chemical Company. All rights reserved.

COURSE DESCRIPTION

This course examines the differences between silicone and organic sealant chemistries, key sealant properties, how and why sealants fail, appropriate sealant systems and installation techniques, and the primary benefits of silicone sealants and coatings for building restoration.

LEARNING OBJECTIVES

Upon completion of this course, participants will be able to:

- Describe the differences between silicone and organic sealant chemistries.
- Identify key sealant properties.
- Explain the functions of nonstructural glazing sealants and select appropriate sealing systems for new construction and renovation applications.
- Explain the function of silicone structural glazing and identify appropriate applications.

LEARNING OBJECTIVES

- Describe appropriate designs for structural vs. weathersealing sealant joints.
- Explain how and why sealants fail.
- Select appropriate sealant systems for different building construction and restoration applications and describe appropriate installation techniques.
- Identify the primary benefits of silicone sealants and coatings for building construction and restoration.

COURSE OUTLINE

- Sealant choices
- Sealant chemistry
- The role sealants play
- Properties
- Applications
- Sealant failure
- Demonstrated silicone performance
- References

YOU HAVE MANY CHOICES WHEN SPECIFYING SEALANTS

- Sealants available: One- and two-part polyurethane, polysulfide, acrylic, hybrid and silicone
- What are the differences, and why does it matter?
- How important is the longevity of a sealant?
- Restoration can cost 2 to 3 times the cost of an original installation … can the building owner afford to do it a third time?



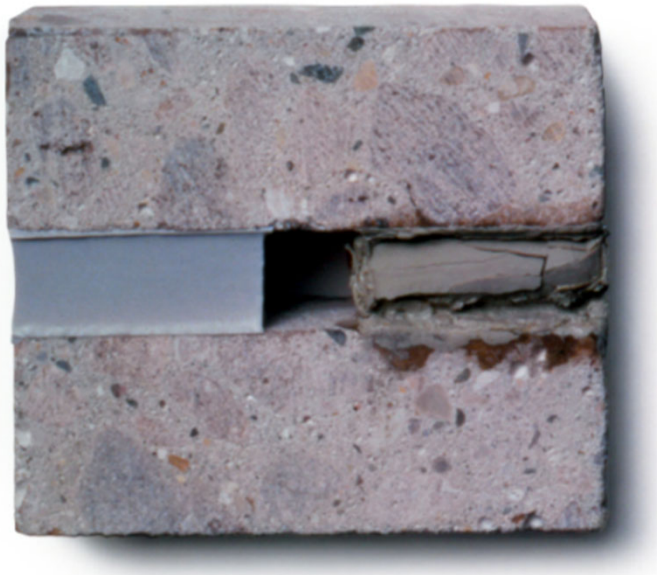
SEALANT CHEMISTRIES

TWO BROAD CATEGORIES AVAILABLE

- **Organic,** which consist of a carbon-based polymer (-C-C-O-C-C-)
  - Single-component and multicomponent polyurethane
  - Polysulfide
  - Acrylic
  - Hybrid
- **Inorganic,** which consist of noncarbon-based polymer (-Si-O-Si-O-Si-)
  - Silicone

WHY IS SEALANT CHEMISTRY IMPORTANT?

- Ultraviolet (UV) light will degrade the carbon-carbon or carbon-oxygen bond of an organic sealant
- There is not enough energy in UV light to degrade the Si-O bond of a silicone sealant
- Therefore, an organic (polyurethane) sealant will degrade in sunlight, and a silicone sealant will be virtually unaffected



POLYURETHANE SEALANT DETERIORATION

How a polyurethane sealant deteriorates from exposure to UV light:

- Hardening
- Chalking
- Crazing
- Cracking
- Reverting



What causes reversion?

- 1991 study evaluated 5 multicomponent polyurethane sealants and 2 silicone sealants
- 4 of 5 polyurethane sealants reverted after accelerated weathering; silicones did not
- 1 polyurethane sealant doubled in modulus
- Conclusion: Ultraviolet light triggers reversion

WHAT IS THE ROLE OF A SEALANT?

- Stop water and air intrusion
- Accommodate differential thermal movement and other structural movements

- Coefficient of thermal expansion (in/in/ºF)
  - Aluminum = 12.9 x 10^{-6}
  - Glass = 5.1 x 10^{-6}
  - Concrete = 6.5 x 10^{-6}
  - Polycarbonate = 38 x 10^{-6}



IMPORTANT SEALANT PROPERTIES

- **Adhesion** to a variety of materials
  - Primers may be required
- **Modulus** – high modulus (stiffest) to ultralow modulus (for high-movement joints)
- **Movement capability** (determined by ASTM C719)
- **Durability** when exposed to UV light, moisture and temperature extremes
  - What are the property changes?

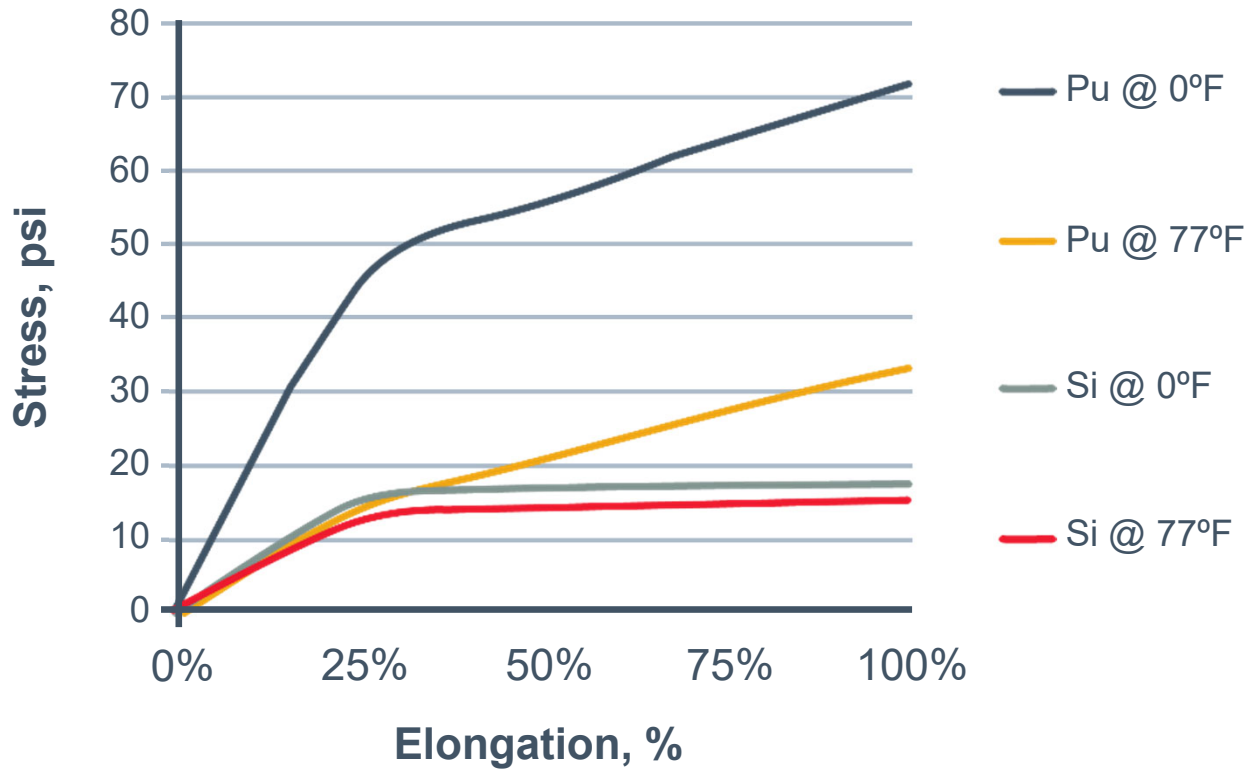
SILICONE SEALANT PROPERTIES

- Excellent UV resistance and physical property retention
- Properties vary with polymers, crosslinkers, fillers, adhesion promoters, fluids, etc.
- Properties that vary include:
  - Adhesion
  - Stain potential
  - Movement capability
  - Modulus

SILICONE SEALANT PROPERTIES



SEALANT MODULUS VS. TEMPERATURE

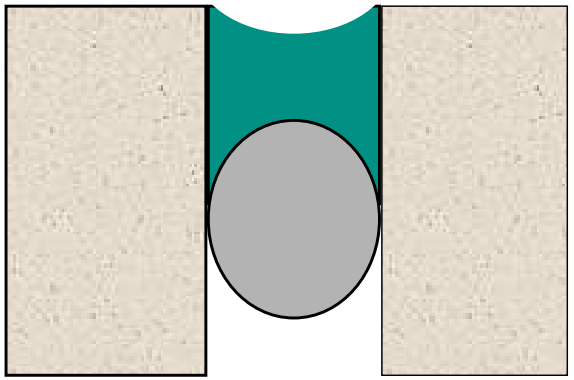


APPLICATIONS

- Weatherseals
- Nonstructural glazing
- Restoration
- Precured silicone sealants
- Exterior insulation and finish systems (EIFS)
- EIFS restoration
- Silicone coatings
- Sensitive substrates
- Parking structures
- Stadiums
- Structural glazing
- Protective glazing

WEATHERSEALS

- Use an hourglass-shaped butt joint for best performance
- 2-to-1 width-to-depth ratio minimum
- Maintain 1/4" contact to each joint surface
- Avoid 3-sided adhesion; use backer rod or bond breaker tape
- Other joint types: fillet joint, bridge joint, double weatherseal



JOINT DESIGN BASICS

- Minimum depth of 1/4" sealant/substrate bond to help ensure adequate adhesion
- Minimum width of 1/4" opening to help ensure sealant flow into joints
- Ensure joint design allows moisture from environmental humidity access to one-part silicone sealants for full cure



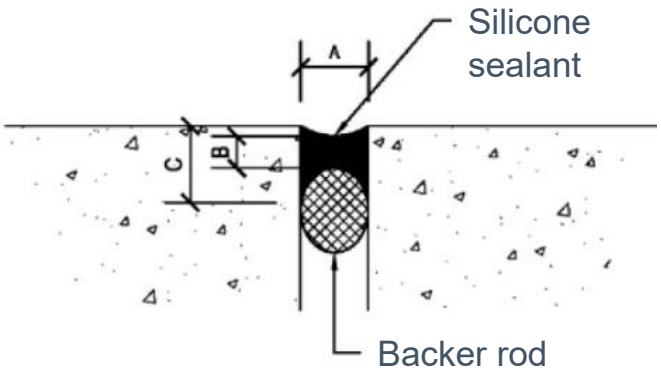
Design of moving joints

- A minimum 1/4" joint width is recommended
- Eliminate three-sided adhesion using a bond breaker tape or backer rod
- A properly designed moving joint with a 2:1 width to depth ratio will accommodate more movement than a thick joint
- As the sealant joint width becomes larger than 1", the depth should be held at approximately 3/8" to 1/2" at maximum
- Joint widths up to 4" can be accommodated with silicone sealants

Typical Joint Designs

Conventional moving weatherseal

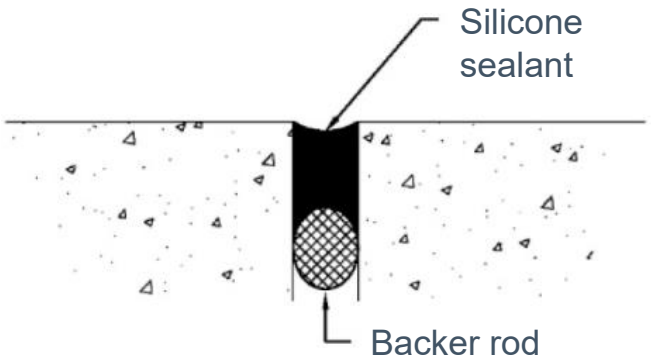
Good joint design



Good joint design – Key points:

1. Dimension A must be at least 1/4" (6 mm).
2. Dimension B must be at least 1/8" (3 mm).
3. Dimension C must be at least 1/4" (6 mm).
4. Ratio of A:B should be 2:1 minimum.
5. Joint surface tooled.
6. Dimension B suggested maximum = 1/2" (12.7 mm).
7. Dimension A maximum = 4" (100 mm). Joints wider than 2" (50 mm) may slump slightly; therefore, double application techniques of the sealant may be required.

Poor joint design

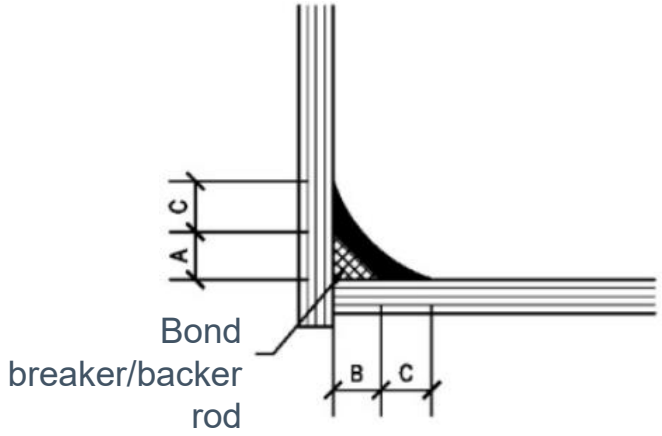


Poor joint design – Concerns:

1. A deep sealant joint will not have the same movement capability as a properly designed joint.
2. Slow cure due to excessive sealant depth.

TYPICAL JOINT DESIGNS
MOVING CORNER JOINTS

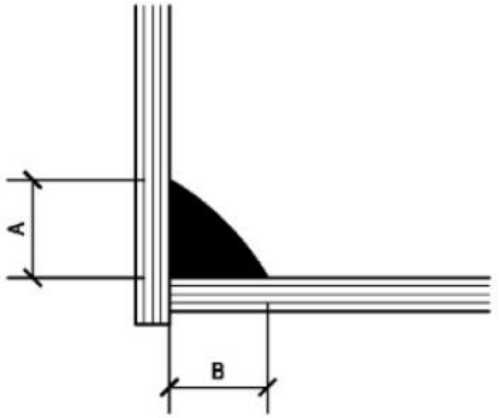
Good joint design



Good joint design – Key points:

1. Dimensions A and B must be at least 1/4" (6 mm).
2. A bond breaker tape or backer rod must be present if joint movement is anticipated.
3. Joint must be tooled flat or slightly concave.
4. Dimension C must be at least 1/4" (6 mm).

Poor joint design

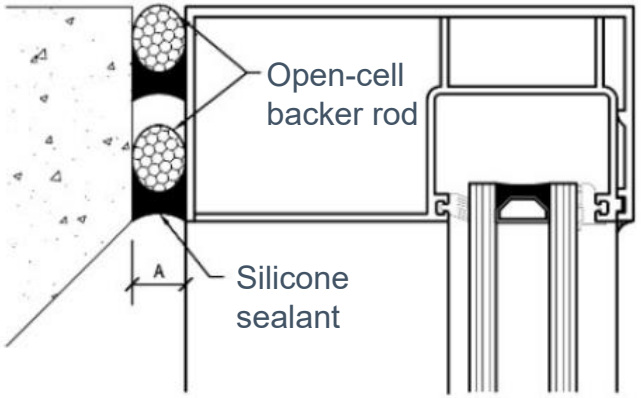


Poor joint design – Concerns:

1. Dimension A or B less than 1/4" (6 mm).
2. Joint not properly tooled.
3. No bond breaker material; therefore, the joint will not accept movement.

TYPICAL JOINT DESIGNS
DUAL-SEAL MOVING WEATHERSEAL

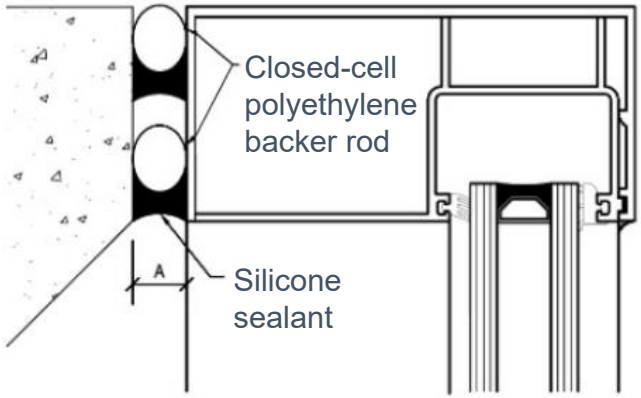
Good joint design



Good joint design – Key points:

1. Both weatherseals comply with the requirements for conventional moving weatherseals (addressed previously).
2. Open-cell backer rod is used to help ensure full cure of the back weatherseal.
3. If closed-cell backer rod is used, the back weatherseal must be fully cured prior to the installation of the exterior seal.
4. Dimension A is at least 3/4" wide to assist application of the rear sealant joint.

Poor joint design

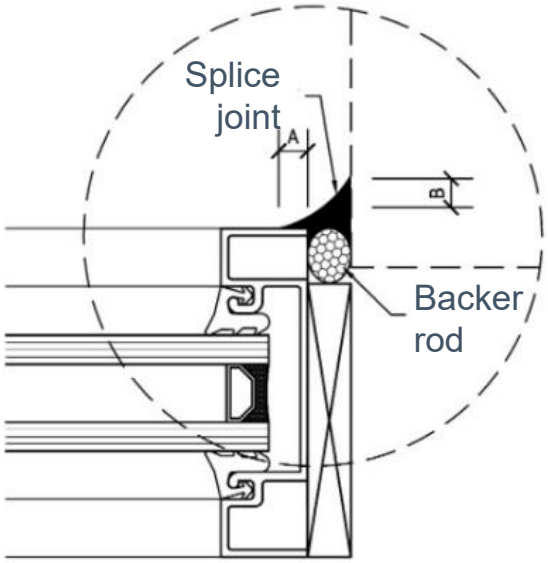


Poor joint design – Concerns:

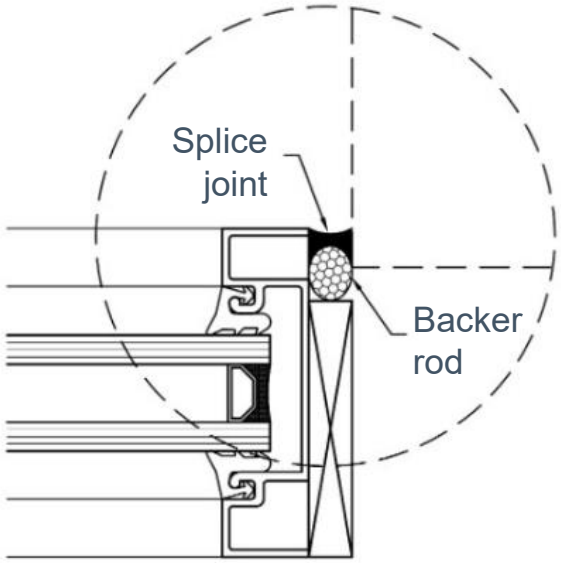
1. If both joints are sealed at or near the same time, the closed-cell backer rod will help prevent moisture from reaching the rear sealant joint, and the sealant will not cure.
2. Dimension A is less than 3/4", making application of rear joint difficult.
3. Exterior joint seal to aesthetic snap-on cap.

TYPICAL JOINT DESIGNS
WINDOW PERIMETER JOINTS

Good joint design



Poor joint design



Good joint design – Key points:

1. Dimensions A and B are each 1/4" (6 mm) or larger.

Poor joint design – Concerns:

1. Attempting to apply sealant onto the edge of (or behind) thin-gauge metal results in inadequate sealant/substrate contact and water leakage.

NONSTRUCTURAL GLAZING

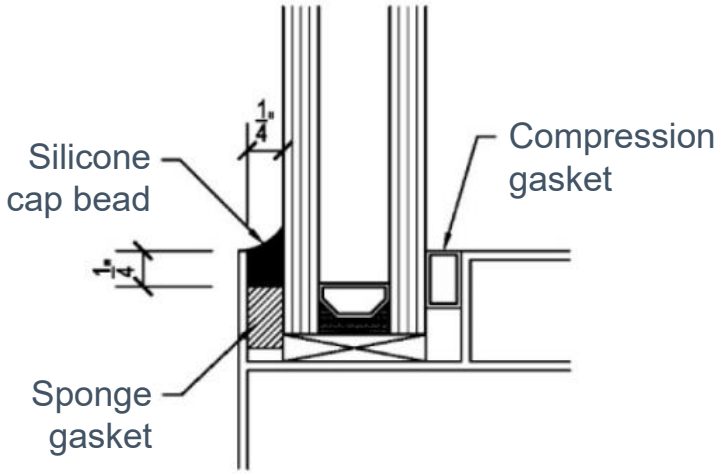
- Glass-to-glass butt joints
- Silicone cap beads
- Internal seals
  - End dams
  - Screw heads
  - Splice joints



TYPICAL GLAZING JOINT DESIGNS

SILICONE CAP BEADS

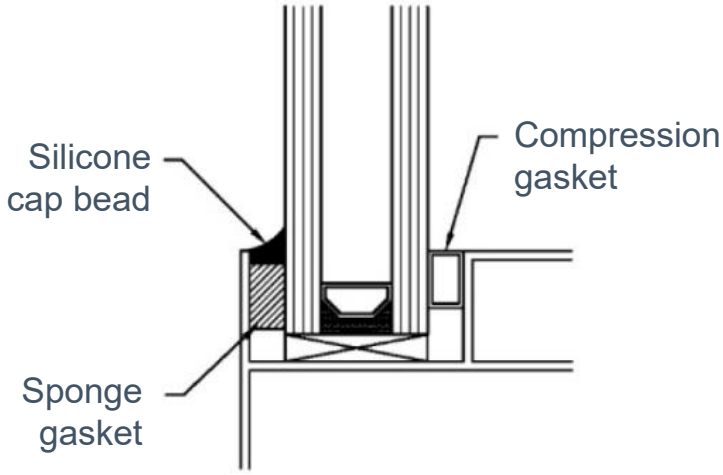
Good joint design



Good joint design – Key points:

1. Adhesion contact on glass and metal is at least 1/4" (6 mm).
2. Silicone is compatible with gasket.
3. Dark-colored sealant masks possible discoloration from the gasket.

Poor joint design



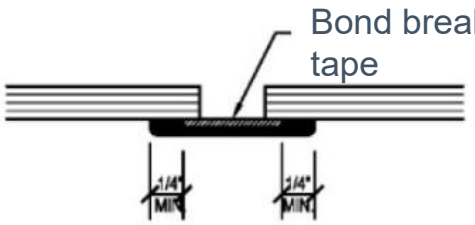
Poor joint design – Concerns:

1. Inadequate contact between sealant and external metal.
2. Gray sealant is prone to discoloration.

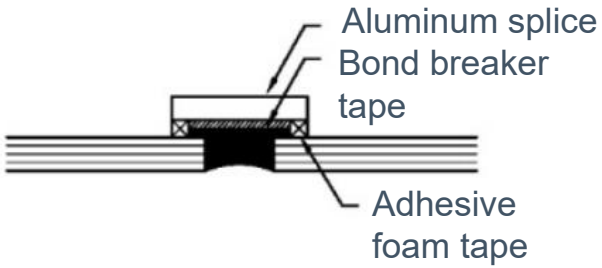
TYPICAL GLAZING JOINT DESIGNS

SPLICE JOINTS

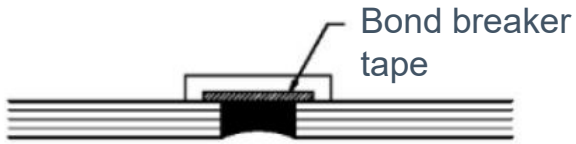
Good joint design



Good joint design



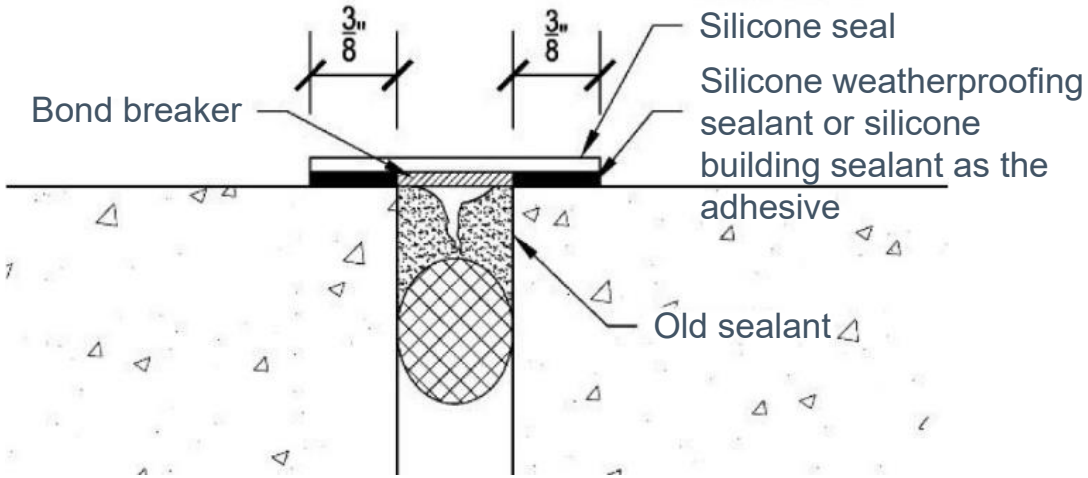
Poor joint design



Key Points:

1. Joint is very difficult to clean.
2. Bond breaker hard to position/size correctly.
3. Movement during cure can cause joint failure.

Best joint design



SEALANT INSTALLATION

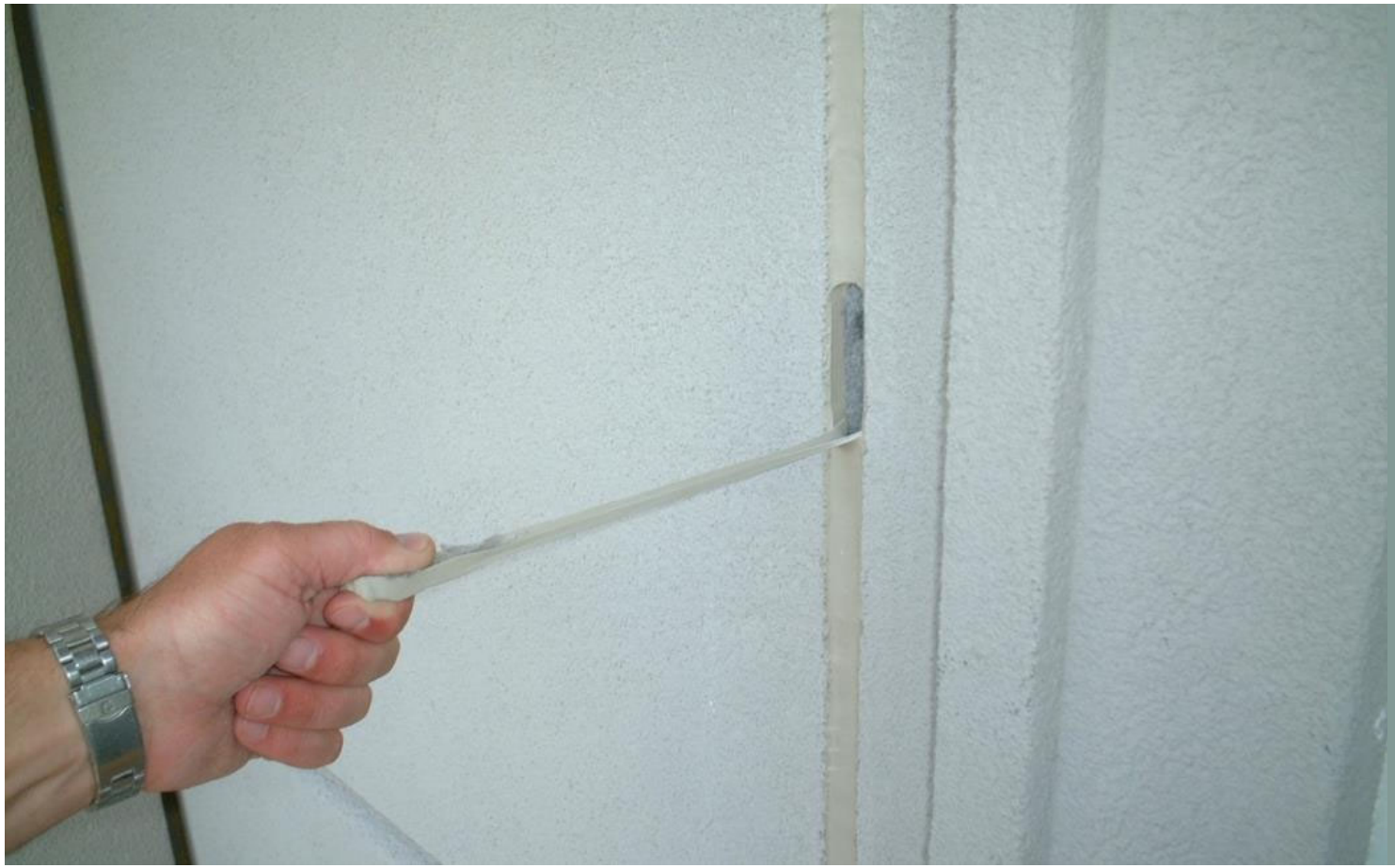
- Clean – clean, dry, frost-free substrates
- Prime as recommended by the sealant manufacturer
- Install backer material sized 25% larger than the joint
- Install sealant and tool
- Perform field adhesion testing – document in quality assurance log







Sealant installation: Adhesion testing



Field adhesion testing verifies sealant adhesion at the job site

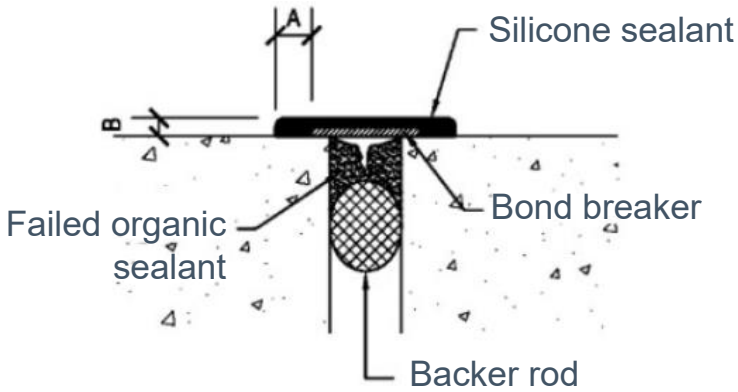
RESTORATION

- Grind off old sealant
- Install test joints before starting the restoration project
- Wet seals – to replace failed gaskets
- Bridge joints – disengage existing sealant joints that are hardened and/or difficult to remove



RESTORATION
BRIDGE JOINTS – WET SEALANTS

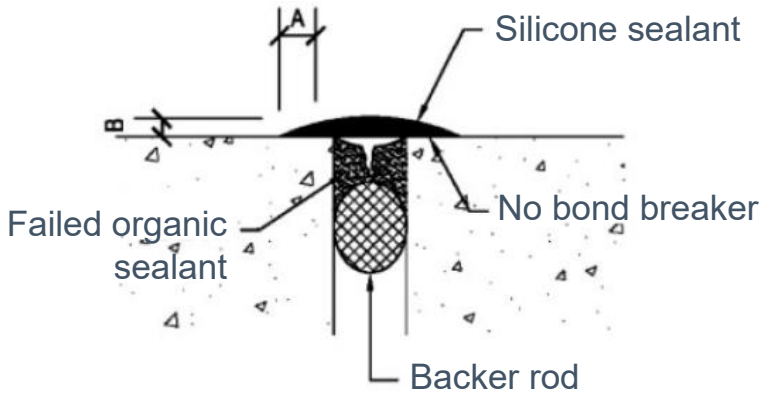
Good joint design



Good joint design – Key points:

1. Dimension A must be at least 1/4" (6 mm).
2. Dimension B must be at least 1/8" (3 mm).
3. Bond breaker tape must be used to isolate fresh sealant from failed organic weatherseal and to allow joint movement.
4. If existing sealant has not lost adhesion to the substrate, disengage it before applying silicone sealant.

Poor joint design



Poor Joint Design – Concerns:

1. Dimension A less than 1/4" (6 mm) increases difficulty in obtaining adhesion and increases the likelihood for voids.
2. Dimension B less than 1/8" (3 mm) increases the likelihood of pinholes or voids in tooling; poor cohesive integrity.
3. No bond breaker material; therefore, the joint will not accept movement.

BRIDGE JOINTS

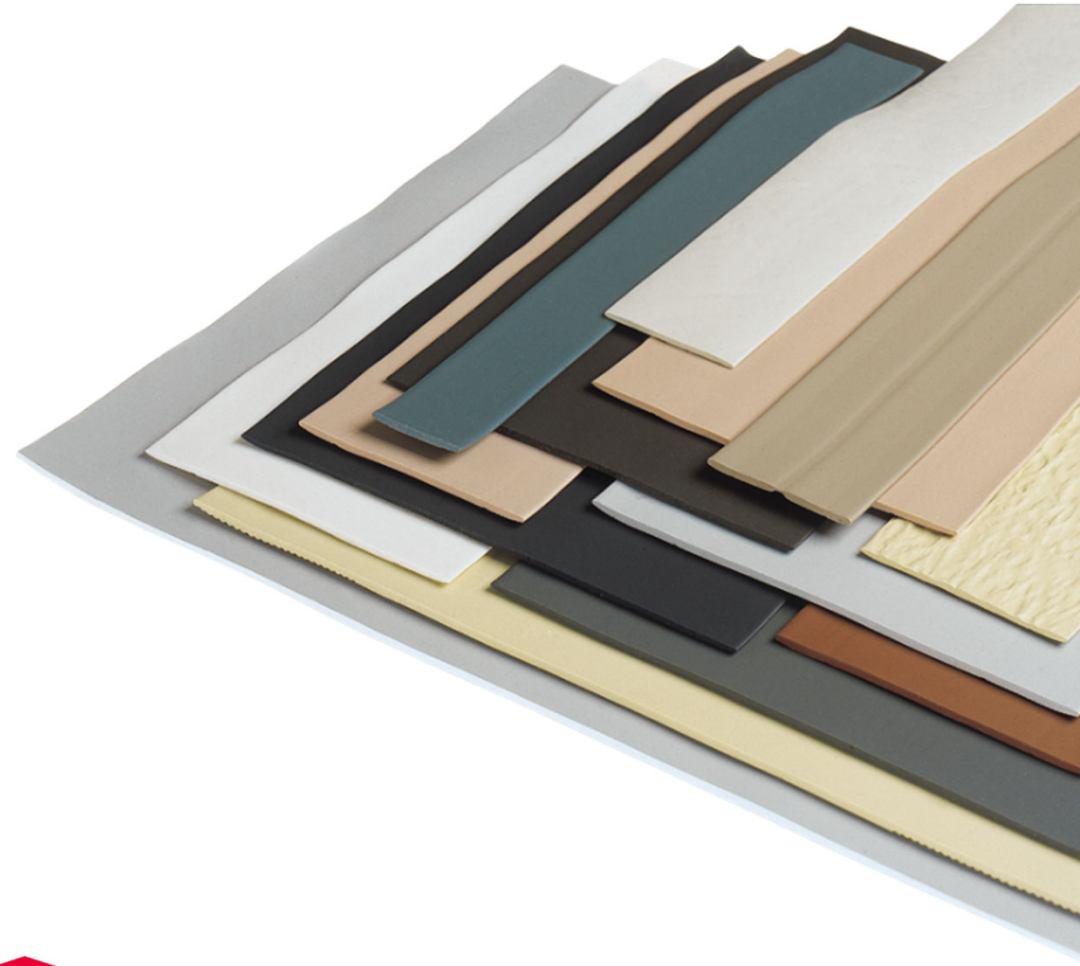


PRECURED SILICONE SEALANTS



PRECURED SILICONE SEALANTS

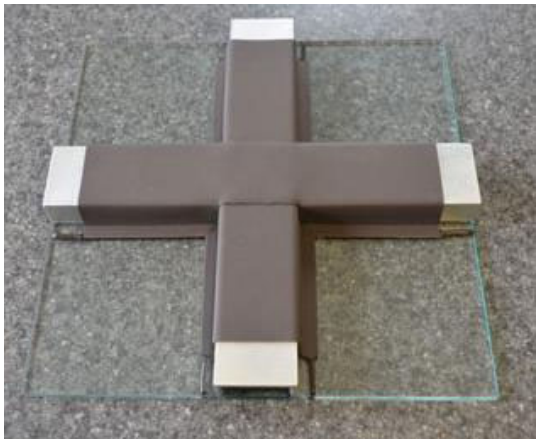
- Weatherseals over difficult-to-remove polyurethane sealant
- Glazing splice joints
- Roof parapet caps
- Aluminum composite panels
- Custom silicone extrusions and molded designs now available

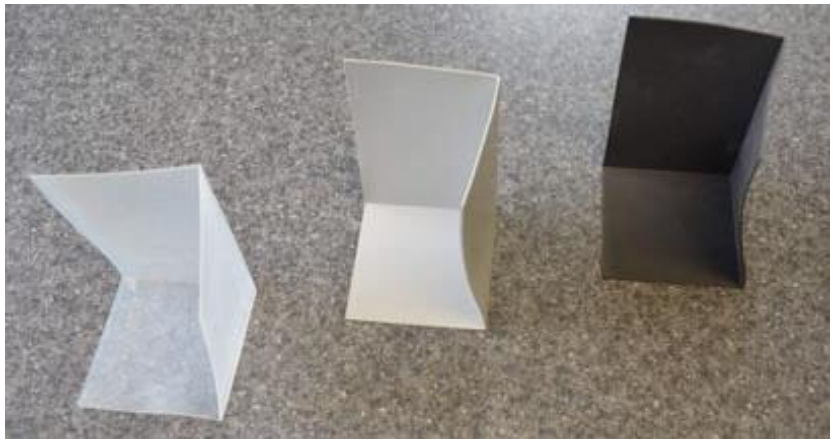


PRECURED SILICONE SEALANTS









Exterior Insulation and Finish Systems (EIFS)

- EIFS is a softer substrate requiring sealants that produce less stress on the substrate
- Silicone sealants offer long-term durability, high movement capability and low modulus, particularly in cold temperatures



Exterior Insulation and Finish Systems (EIFS)

- EIFS coating delamination can be caused by the stiffness of the sealant
- A low-modulus silicone sealant applies less stress to the substrate



EIFS JOINT RESTORATION

- EIFS joint restoration is complex due to the difficulty in removing failed polyurethane sealant without damaging the EIFS substrate
- The use of a precured silicone sealant bridge joint and silicone elastomeric coating offers a cost-effective, aesthetically pleasing, watertight result



SILICONE ELASTOMERIC COATING

- Water-based, one-part silicone emulsion
- 50% solids by weight
- Easily applied by roller, brush or spray
- At least 10 mil dry film thickness
- VOC compliant



SILICONE ELASTOMERIC COATING

- Long-term silicone flexibility
- High permeability (average 43 metric perms at 10 mil dry film thickness)
- Suitable for use on concrete, stucco, EIFS, brick



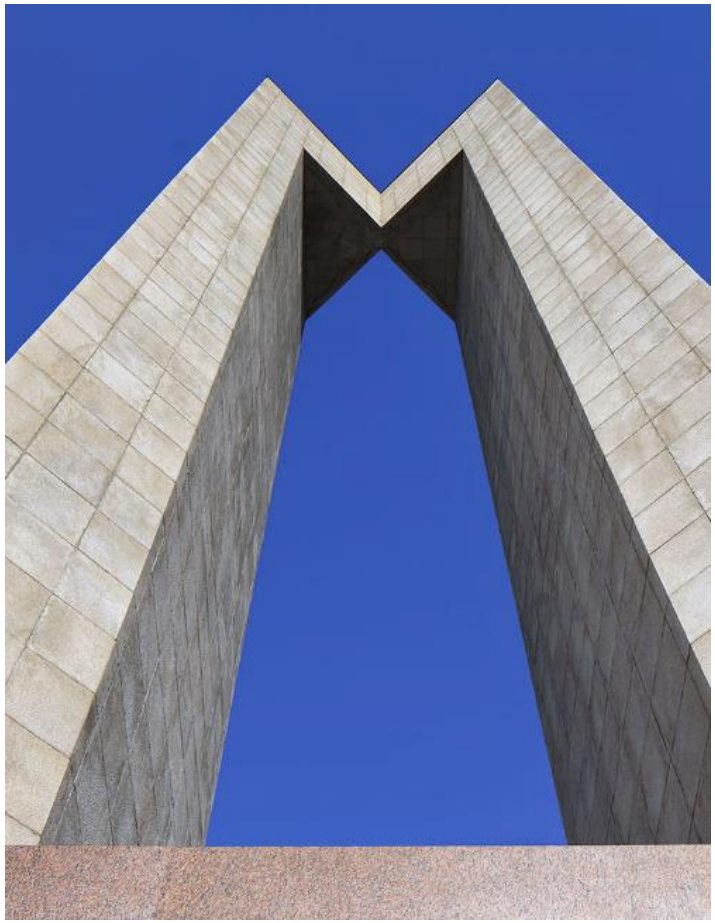
Staining of sensitive substrates

- Staining is caused by nonreacted fluids in the sealant formulation
- Any sealant can stain if poorly formulated or used on a nonrecommended substrate
- Require stain testing per ASTM C1248 and a nonstaining warranty from the sealant manufacturer



CLEAN SILICONE SEALANTS

- Silicone sealants are available for sensitive substrates
- These sealants will not stain the most porous stone types, including Vermont and Italian white marbles
- Surface modifiers reduce dirt pickup and minimize streaking on metal panel systems



PARKING STRUCTURES

- Expansion joints
  - Fast-cure sealant
- Control joints
  - Self-leveling
- Cove beads
- Vertical joints
  - Nonsag sealant



STRUCTURAL GLAZING

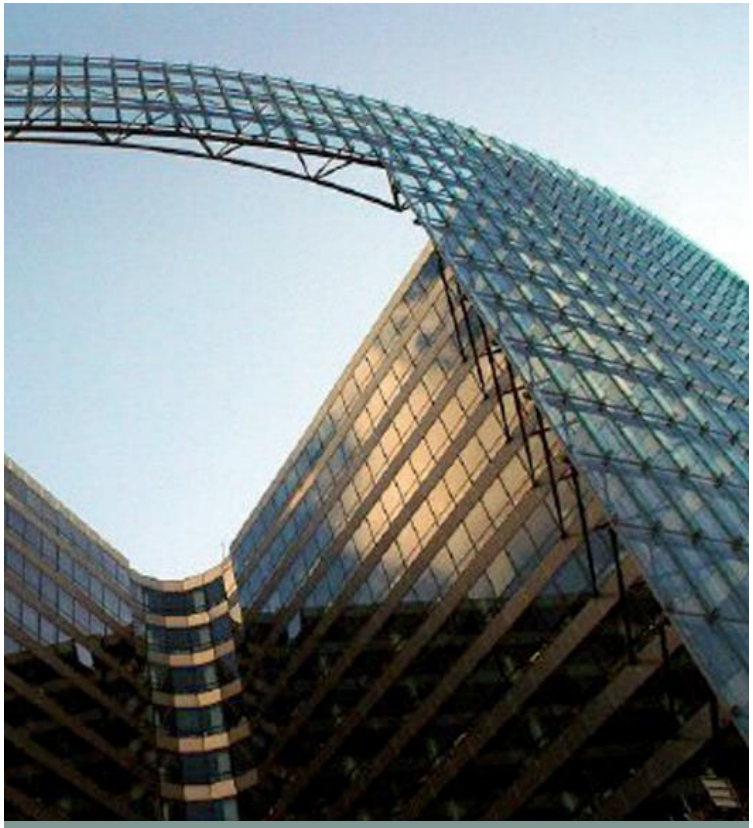
- Silicone sealant adheres glass to the structure
- Sealant allows wind load to be transferred to the structure
- Sealant must be strong but flexible to accommodate thermal expansion
- Sealant must have a long life
- Only silicones can be used for structural glazing



STRUCTURAL GLAZING

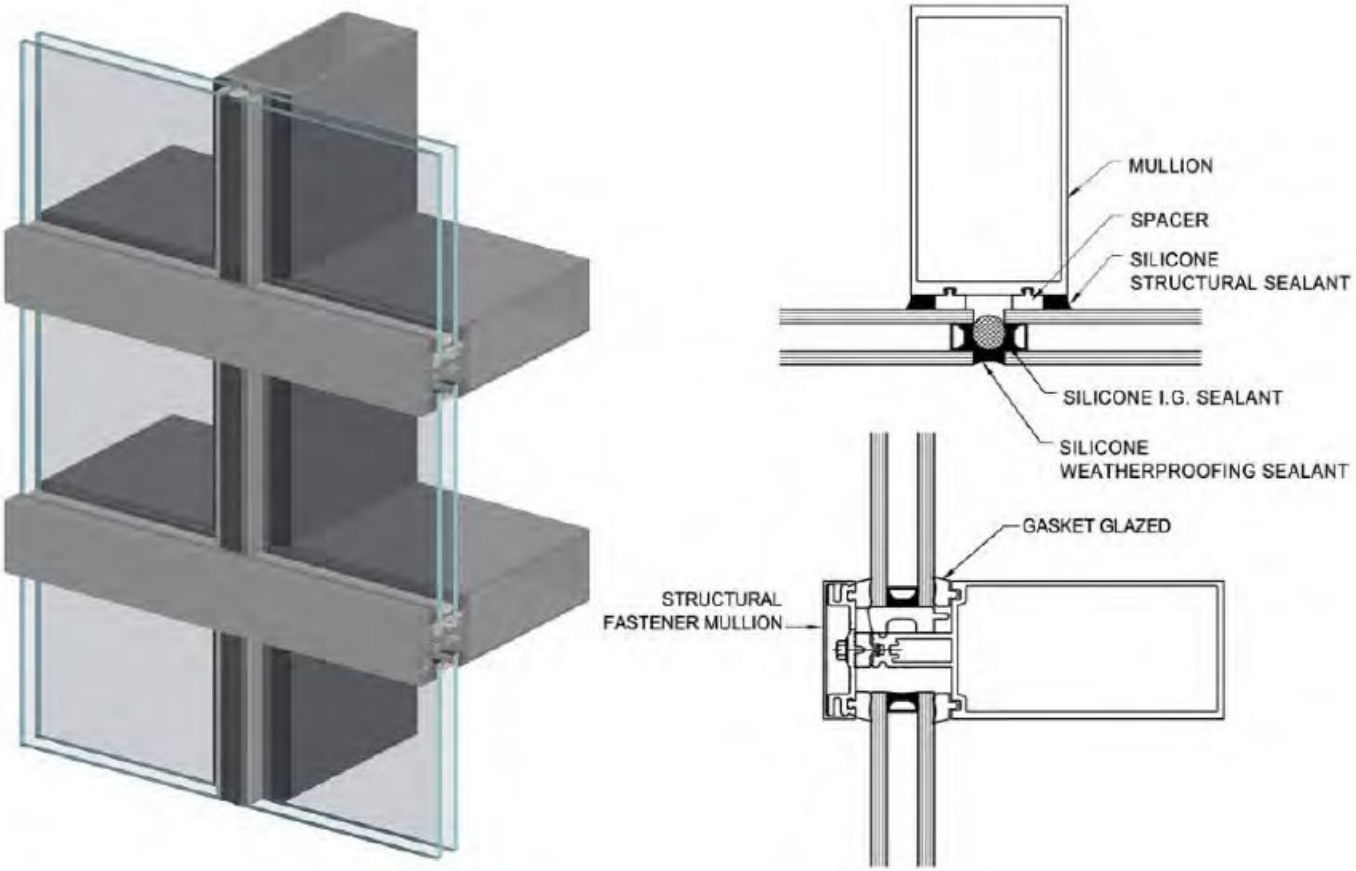


4-sided silicone structural glazing

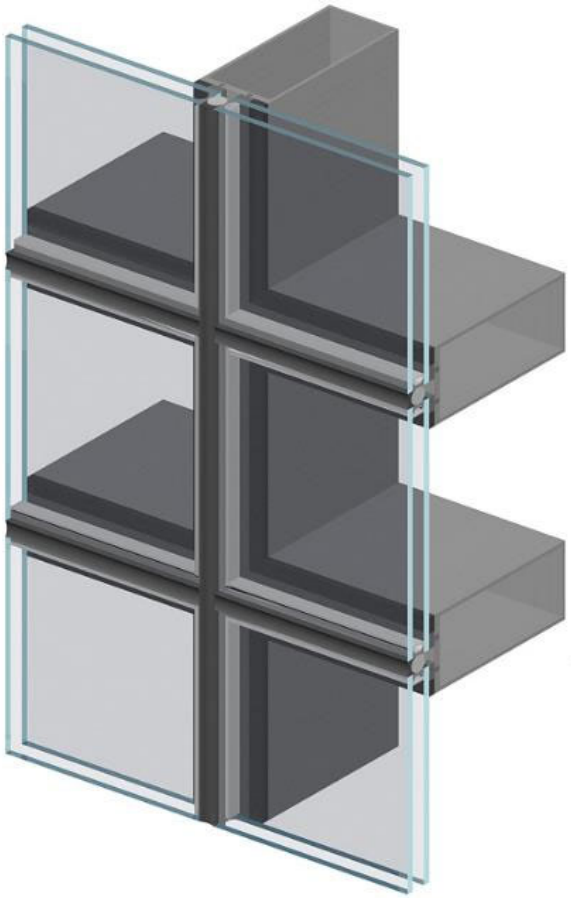


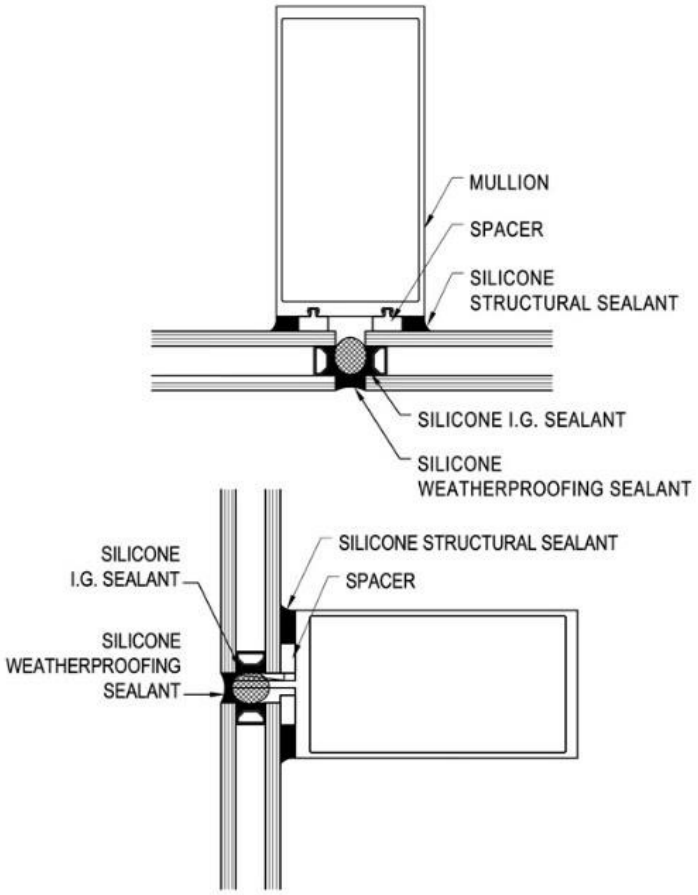
2-sided silicone structural glazing

2-SIDED STRUCTURAL GLAZING



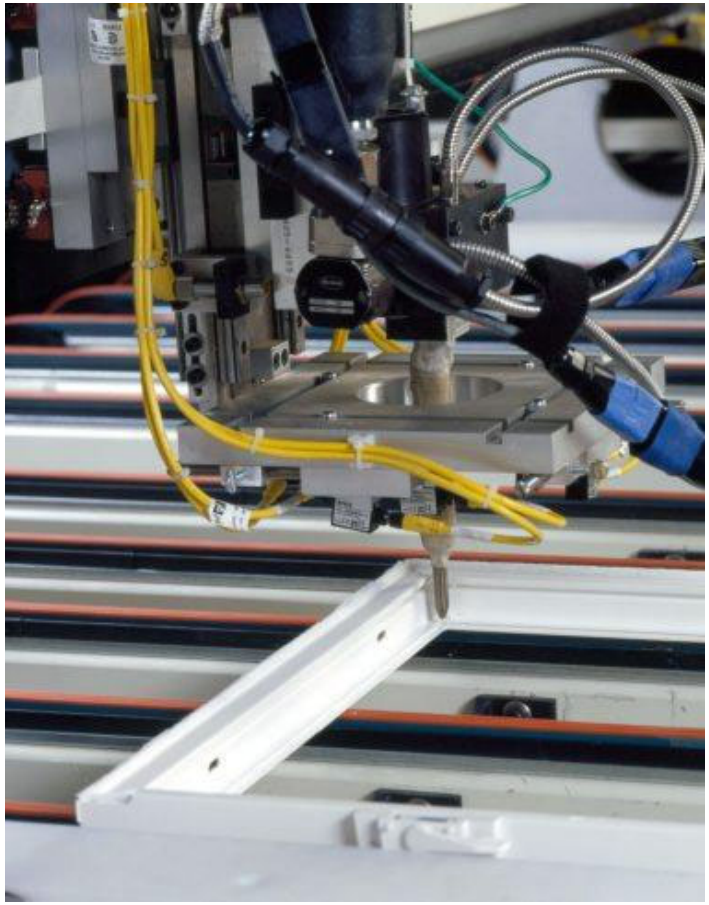
4-SIDED STRUCTURAL GLAZING





APPLICATION METHODS

- Factory (shop) glazing
- Site (field) glazing



APPLICATION METHODS

- Structural glass systems (bolted or point-fixed glazing)
- Total vision systems (fin glazing)
- Structural attachment of nonglass materials
- Panel stiffeners
- Protective glazing systems

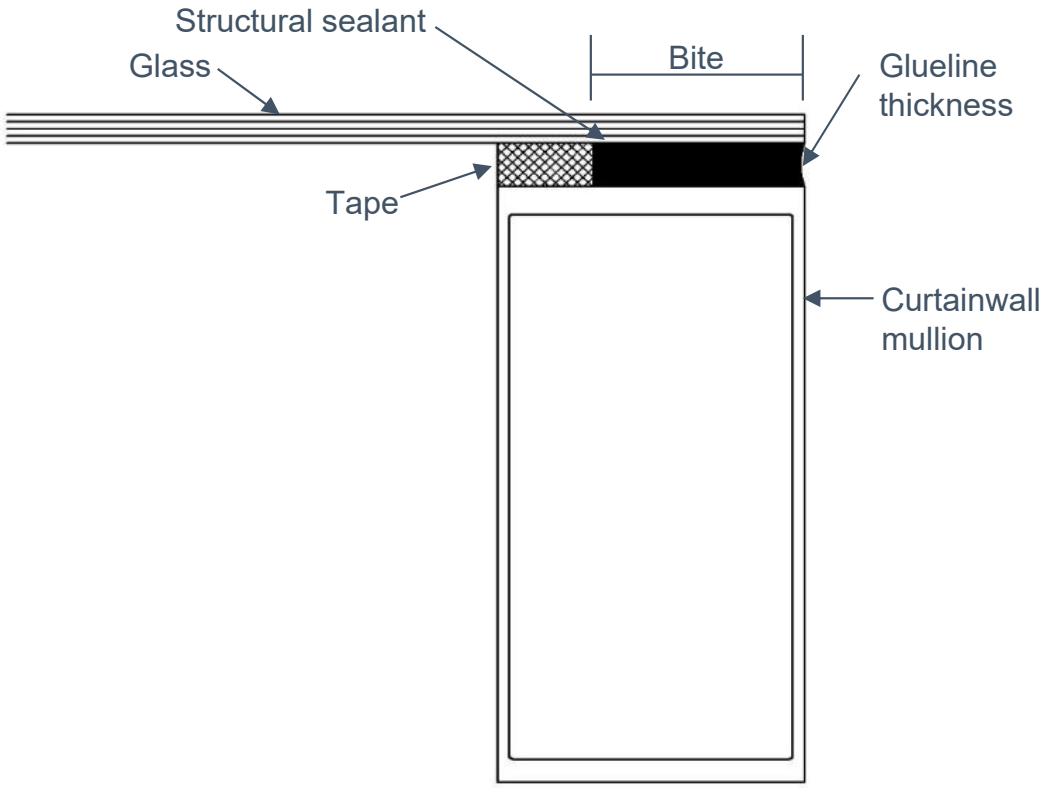
STRUCTURAL GLAZING DESIGN GUIDELINES

- The structural bite must be a minimum of 1/4"
- The glueline thickness must be a minimum of 1/4"
- The structural bite must be equal to or greater than the glueline thickness
- For one-part sealant, the bite-to-glueline ratio must be between 1:1 and 3:1
- The structural sealant joint must be able to be filled using standard sealant application procedures

STRUCTURAL GLAZING DESIGN GUIDELINES

- The joint design must allow the sealant exposure to air so it can cure and obtain its ultimate physical properties
- For two-part sealant, the bite-to-glueline ratio may be greater than 3:1 with the understanding that the joint can be properly filled and the two-part materials are mixed at proper ratio during application
- The structural sealant joint must be fully cured and adhered prior to removing temporary fasteners in the field
- Before moving units in-shop, fabricators should verify that substantial cure has occurred and adhesion has been achieved

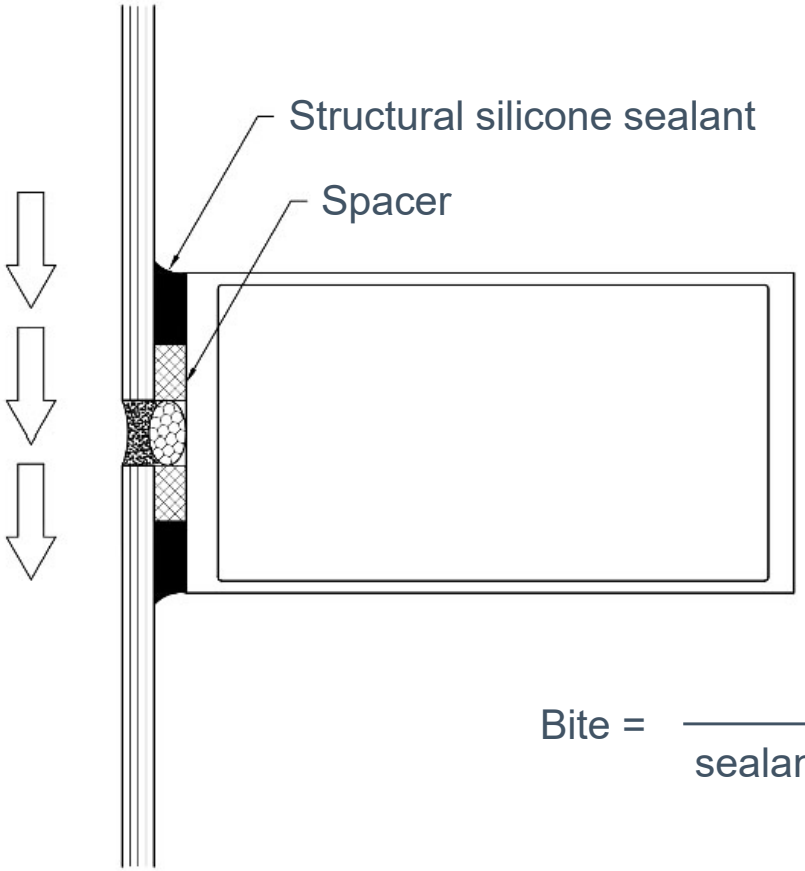
STRUCTURAL GLAZING DESIGN



Bite ≥ Glueline thickness ≥ 1/4 in.

$$\text{Bite} = \frac{\text{1/2 glass shortspan x design wind load}}{\text{sealant design strength}}$$

STRUCTURAL GLAZING DESIGN
DEADLOAD



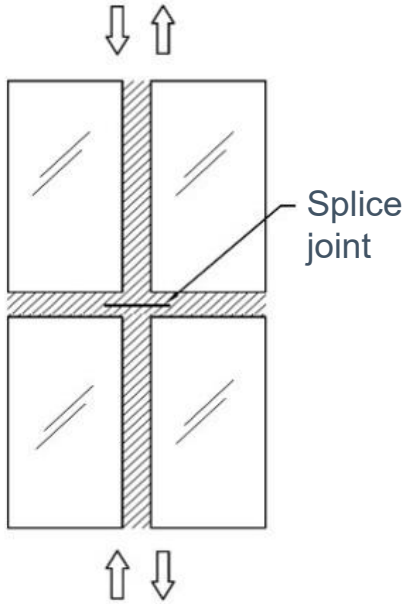
$$\text{Bite} = \frac{\text{weight of glass in lb}}{\text{sealant contact length in inches} * \text{sealant design strength (1 psi)}}$$

STRUCTURAL GLAZING DESIGN

SPLICE JOINT IN CURTAINWALLS

Best design

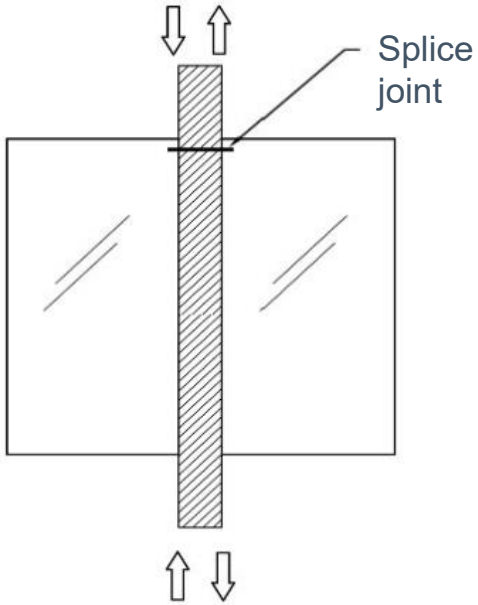
Live load and thermal movement from above



Live load and thermal movement from below

Better design

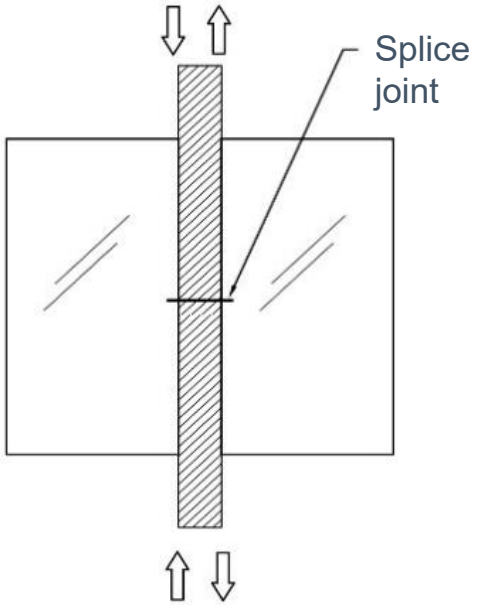
Live load and thermal movement from above



Live load and thermal movement from below

Poor design

Live load and thermal movement from above



Live load and thermal movement from below

PROTECTIVE GLAZING

- Building codes require the use of windows that can withstand flying debris from hurricanes or other severe weather
- Window systems that use laminated glass and a silicone sealant to anchor the laminated glass in the window frame have successfully passed the demanding missile-impact test



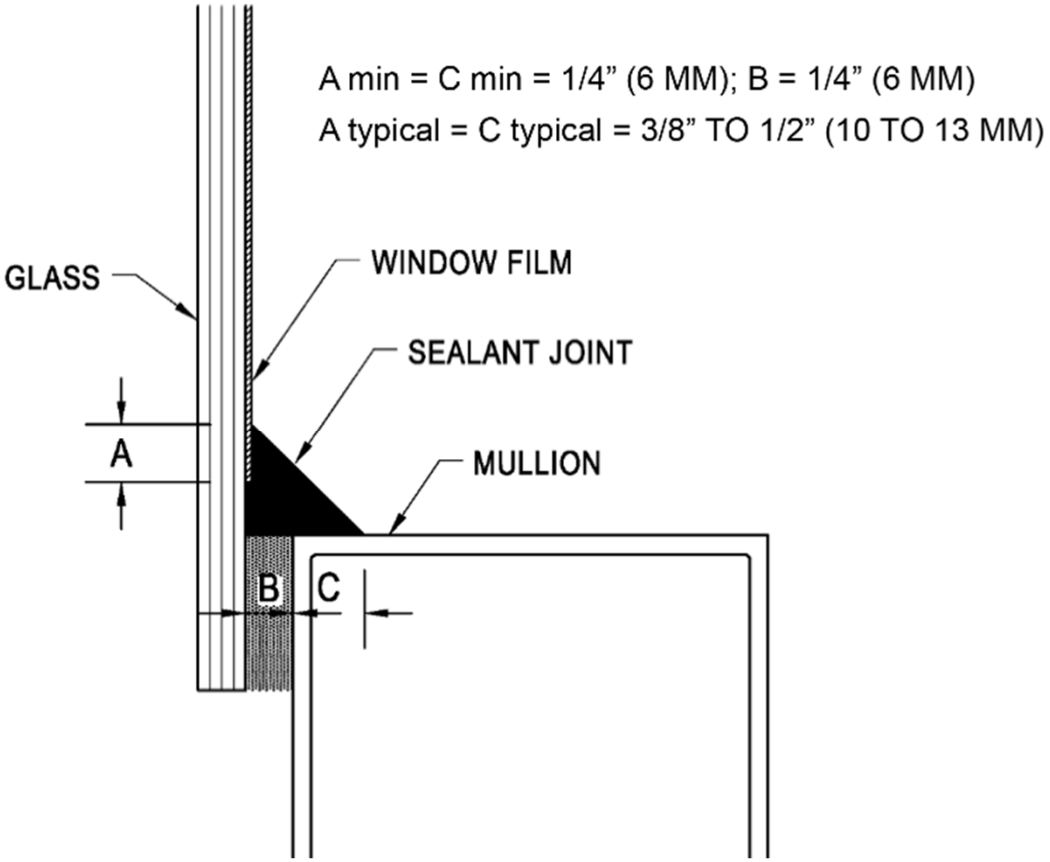
BLAST-RESISTANT
GLAZING

- Silicone sealant is used to anchor laminated glass or a protective film in a window frame during bomb-blast testing or computer-simulated evaluations



Image courtesy of Grendon Design Agency

IMPACT-RESISTANT GLAZING JOINT DESIGN



References

- ASTM C719 Movement Capability Test Method
- ASTM C794 Adhesion in Peel Test Method
- ASTM C920 Standard Sealant Specification
- ASTM C1184 Structural Glazing Specification
- ASTM C1193 Guide for Use of Sealants
- ASTM C1248 Stain Test Method
- ASTM C1299 Guide for Selection of Sealants
- ASTM C1401 Guide to Structural Glazing
- ASTM C1472 Guide for Calculating Joint Movement
- ASTM C1481 Guide to Use of Sealants with EIFS

In Summary, silicone sealants offer …

- Longevity
- Versatility
- Aesthetics
- Value
- Demonstrated performance



THANK YOU

This concludes the American Institute of Architects Continuing Education System Program “Silicone Sealants and Coatings for Building Construction and Restoration.”

For more information, contact:
dow.com/buildingscience





Any

questions?

DOWSIL™ Brand Weatherseal Sealants

- **DOWSIL™ 790 Silicone Building Sealant** (+100/-50%) – ultralow-modulus expansion joint sealant; well-suited for porous substrates
- **DOWSIL™ 791 Silicone Weatherproofing Sealant** (±50%) – economical, medium-modulus general weatherseal sealant
- **DOWSIL™ 795 Silicone Building Sealant** (±50%) – versatile industry standard for use as structural and weatherseal sealant
- **DOWSIL™ Contractors Weatherproofing Sealant** (±25%) – excellent silicone performance at a urethane-competitive price
- **DOWSIL™ Contractors Concrete Sealant** (±50%) – excellent primerless adhesion to most porous substrates at a urethane-competitive price

DOWSIL™ 756 SMS Building Sealant

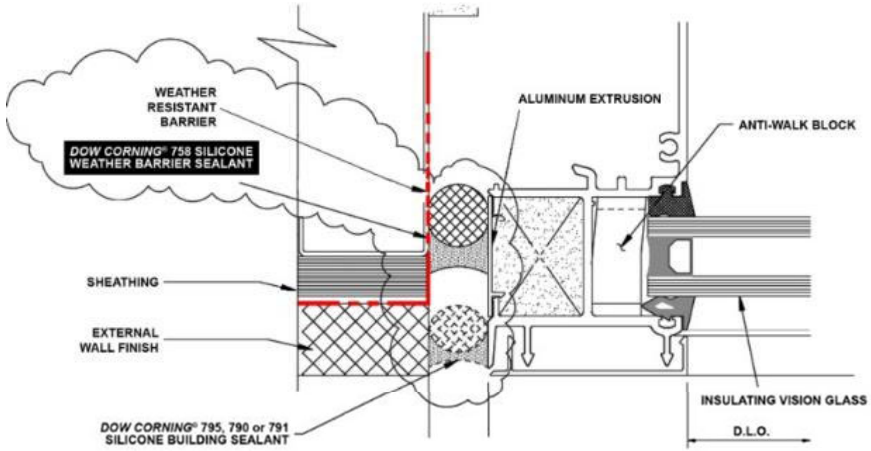
- Clean sealant technology for weathersealing sensitive substrates
- One-part formulation
- Low staining potential
- Reduced dirt pickup
- Unprimed adhesion to both porous and fluoropolymer-painted substrates
- ±50% extension/compression capability



Image courtesy of the city of San Jose

DOWSIL™ 758 Silicone Weather Barrier Sealant

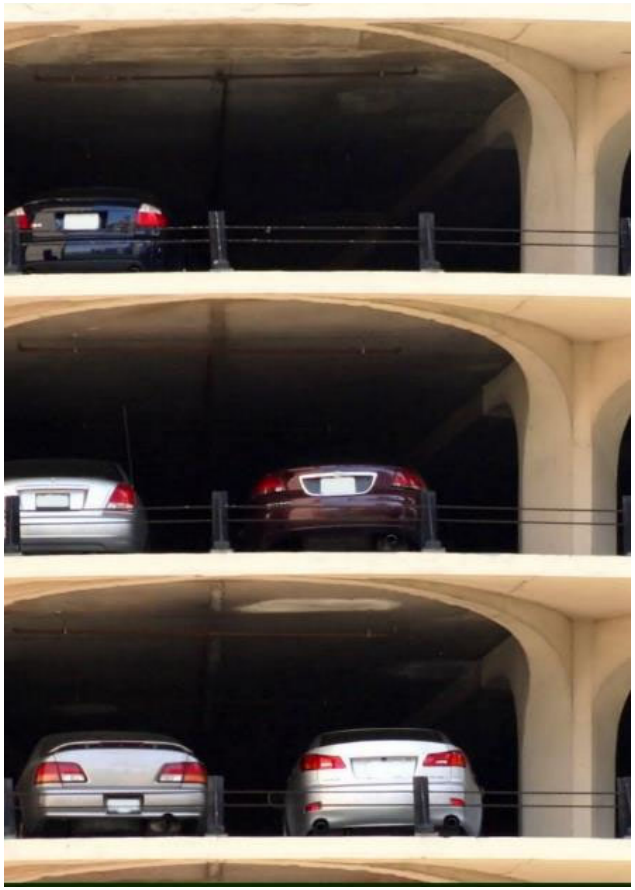
- One-part neutral-cure sealant
- ±25% movement capability in properly designed joint
- Adheres to many polyethylene-film-based weather barriers, spun-bonded polyolefin and fibrous air barriers, flashing, and liquid elastomeric weather barriers
- Adheres to common fenestration substrates – anodized aluminum, vinyl, PVC and high-performance coatings
- Priming not required on most surfaces





DOWSIL™ Brand Parking Structure Sealants

- **DOWSIL™ NS Parking Structure Sealant** – nonsag sealant for horizontal and vertical control and expansion joints
- **DOWSIL™ SL Parking Structure Sealant** – self-leveling sealant for horizontal control and expansion joints
- **DOWSIL™ FC Parking Structure Sealant** – fast-curing, self-leveling two-component sealant for dynamic expansion joints



DOWSIL™ 123 Silicone Seal

- High movement (+200/-75%) for new and remedial construction
- Widths from 1" to 12"
- Available in standard and custom colors, EIFS textures and notched
- DOWSIL™ 123 Silicone Seal Custom Designs H.C. – Engineered extrusions and molded silicone pieces for new and remedial construction



DOWSIL™ ALLGUARD Silicone Elastomeric Coating

- Waterproof coating for above-grade exterior masonry substrates
- 2-coat water-based coating (10 mil DFT)
- SWR Institute validated
- 50% solids by volume
- 10-year warranty available + 10-year recoat warranty



DOWSIL™ Brand Structural glazing sealants

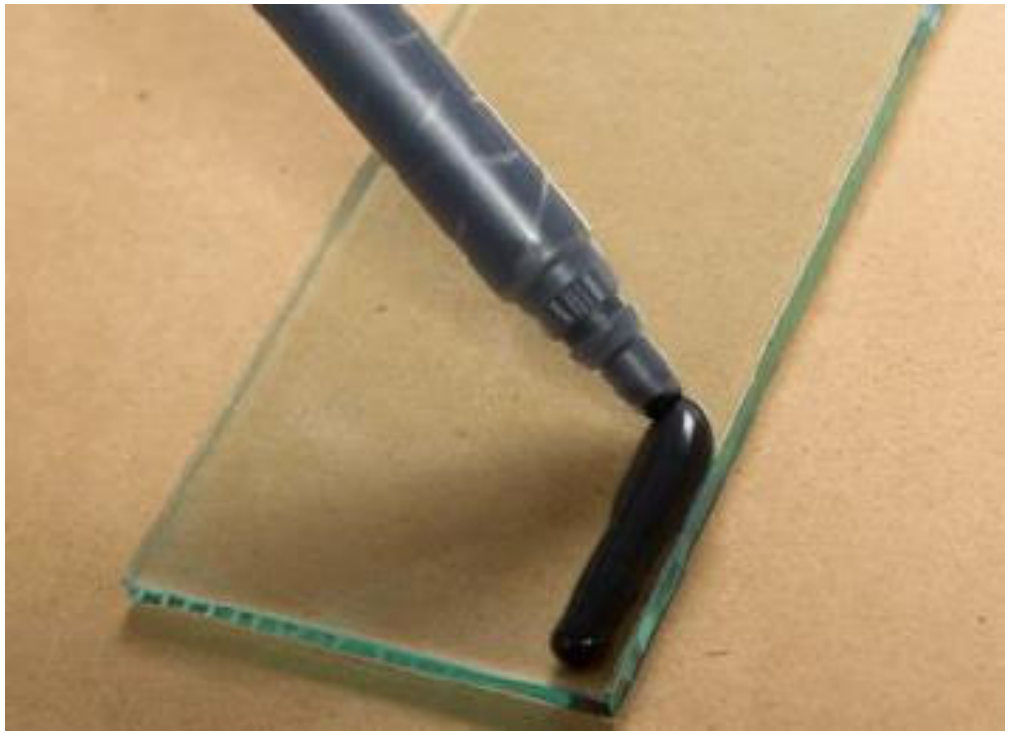
- **DOWSIL™ 795 Silicone Building Sealant** – one-component industry standard for on-site glazing
- **DOWSIL™ 995 Silicone Structural Sealant** – one-component, high-strength sealant for on-site and protective glazing
- **DOWSIL™ 983 Structural Glazing Sealant** – two-component, fast-cure, in-shop sealant for unitized curtainwall and protective glazing



Image courtesy of Senarq S A

DOWSIL™ 121 Structural Glazing Sealant

- Approved for structural and weatherseal applications
- Used for in-shop glazing or field repair/replacement
- Primerless adhesion to glass, alodine and anodized aluminum
- Adhesion to DOWSIL™ structural sealants for reglazing applications
- Adhesion and structural strength achieved in 24 to 48 hours
- Addresses ASTM C719 Class 25 (G, A, O)
- Addresses ASTM C1184 Structural Sealant Specification



DOW SERVICES

- 50+ year track record in construction
- Technical leadership (R&D, patents, ASTM)
- Authorized distributors
- Laboratory testing for adhesion, compatibility and staining
- Offering 20-year weatherseal, nonstaining and structural adhesion warranties
- Website: **dow.com/buildingscience**



AIA MASTER SPEC

- We will review your specification for you and offer recommendations at no charge; send specifications directly to our review department
- Specs are available on **dow.com/constructionsubmittal**

THANK YOU



Cornish College of the Arts Student Housing
Photo credit:
©Ankrom Moisan Architects and Casey Braunger

ICE Krakow
Photo credit:
Courtesy of Wojciech Wandzel

Shenzen Ping
Photo credit:
Ping An Insurance Group

Façade of the ICE Krakow Kongress
Photo Credit:
Courtesy of G Ziemianski

Baku Towers
Photo credit:
Photography by Farid Khayrulin, Design HOK

TSSA-Press Glass
Photo credit:
TSSA-Press Glass

Dow has not performed architectural, engineering or other professional services in connection with any of the projects referenced herein, and Dow assumes no responsibility for any design, specifications, windload requirements, materials, samples, design elements, or testing of any design components, including the adequacy or completeness of the same, supplied or used by any party. Dow will only warrant products as set forth in a separate executed Dow warranty.

PRODUCT SAFETY INFORMATION REQUIRED FOR SAFE USE IS NOT INCLUDED IN THIS DOCUMENT. BEFORE HANDLING, READ PRODUCT AND SAFETY DATA SHEETS AND CONTAINER LABELS FOR SAFE USE, PHYSICAL AND HEALTH HAZARD INFORMATION. THE SAFETY DATA SHEET IS AVAILABLE ON THE DOW WEBSITE AT WWW.DOW.COM, OR FROM YOUR DOW SALES APPLICATION ENGINEER, OR DISTRIBUTOR, OR BY CALLING DOW CUSTOMER SERVICE.

NOTICE: No freedom from infringement of any patent owned by Dow or others is to be inferred. Because use conditions and applicable laws may differ from one location to another and may change with time, Customer is responsible for determining whether products and the information in this document are appropriate for Customer's use and for ensuring that Customer's workplace and disposal practices are in compliance with applicable laws and other government enactments. The product shown in this literature may not be available for sale and/or available in all geographies where Dow is represented. The claims made may not have been approved for use in all countries. Dow assumes no obligation or liability for the information in this document. References to "Dow" or the "Company" mean the Dow legal entity selling the products to Customer unless otherwise expressly noted. NO WARRANTIES ARE GIVEN; ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ARE EXPRESSLY EXCLUDED.

®™ Trademark of The Dow Chemical Company ("Dow") or an affiliated company of Dow

© 2026 The Dow Chemical Company. All rights reserved.

2000024823-1404502 Form No. 63-6573-01-0826 S2D