Sealants: A Sticky Situation

TREMCO™

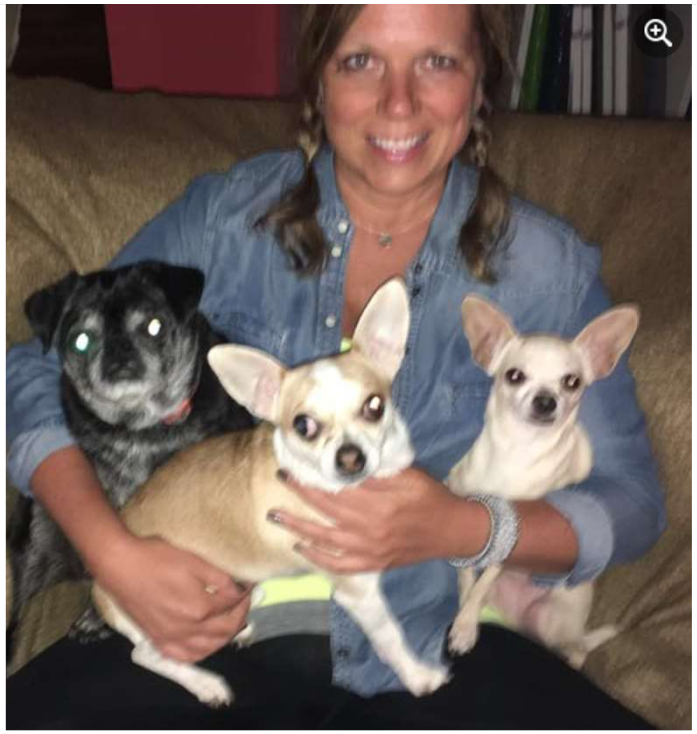
Construction Products Group

TREMCO™

Dryvit™

Nudura™

Willseal™



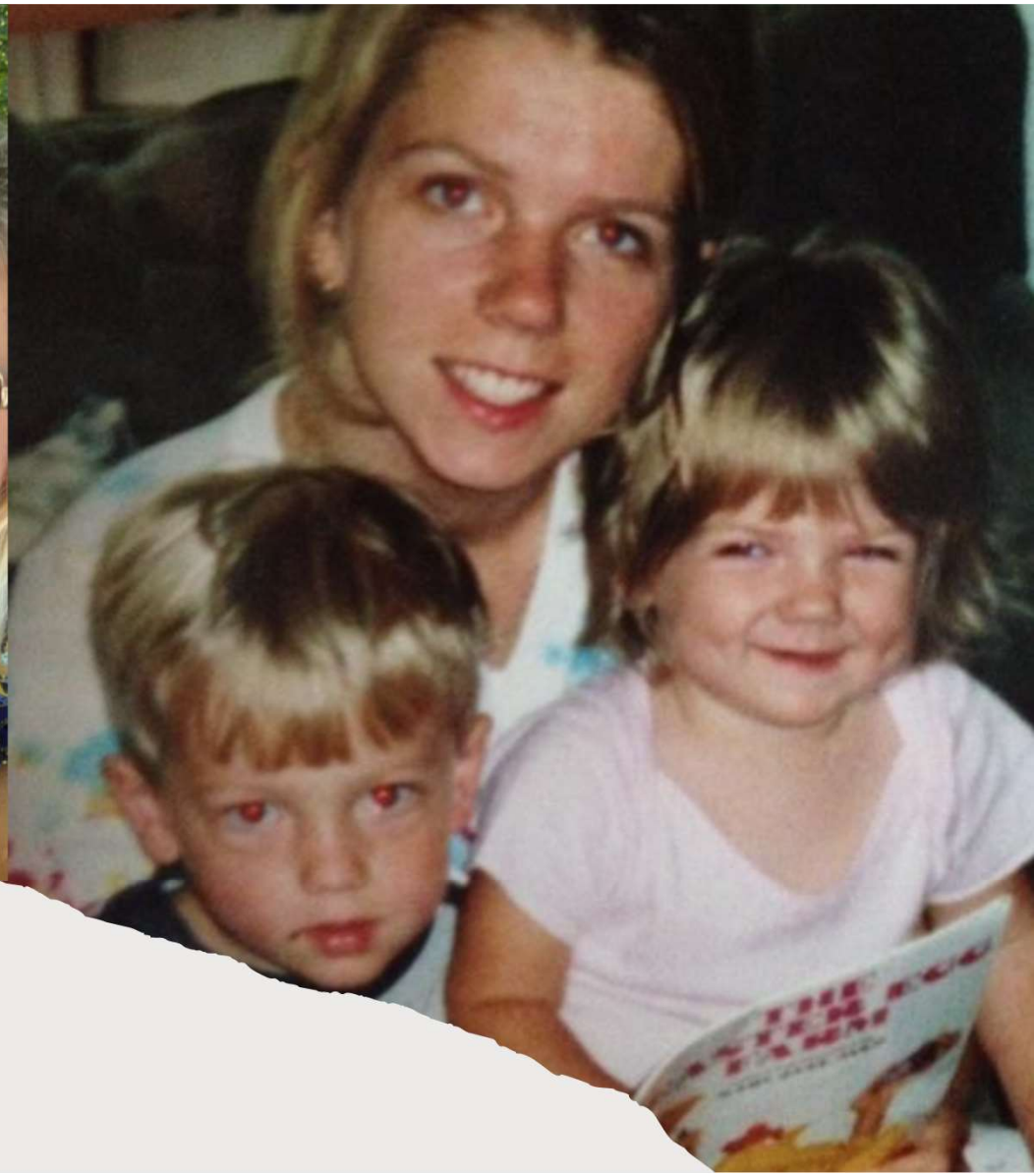
The Dog Photos


Mr. Pumpkin: He Even Talks!


DAVID J. KRAHE FAMILY

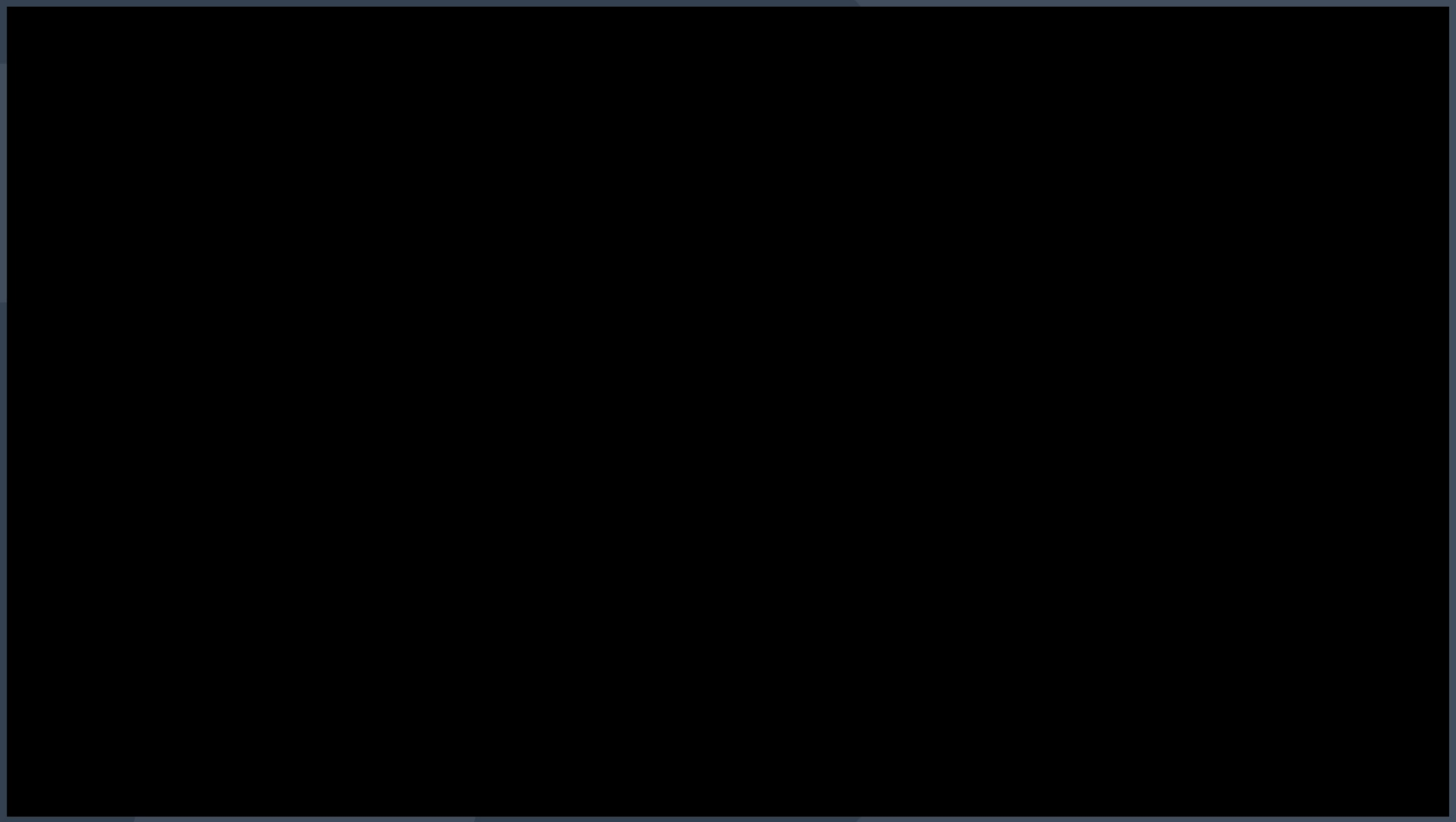

NEW
ERA


GREETINGS
MIKE
MICHELE
MARY
MAUREEN
MATT
MARCYANN
1973

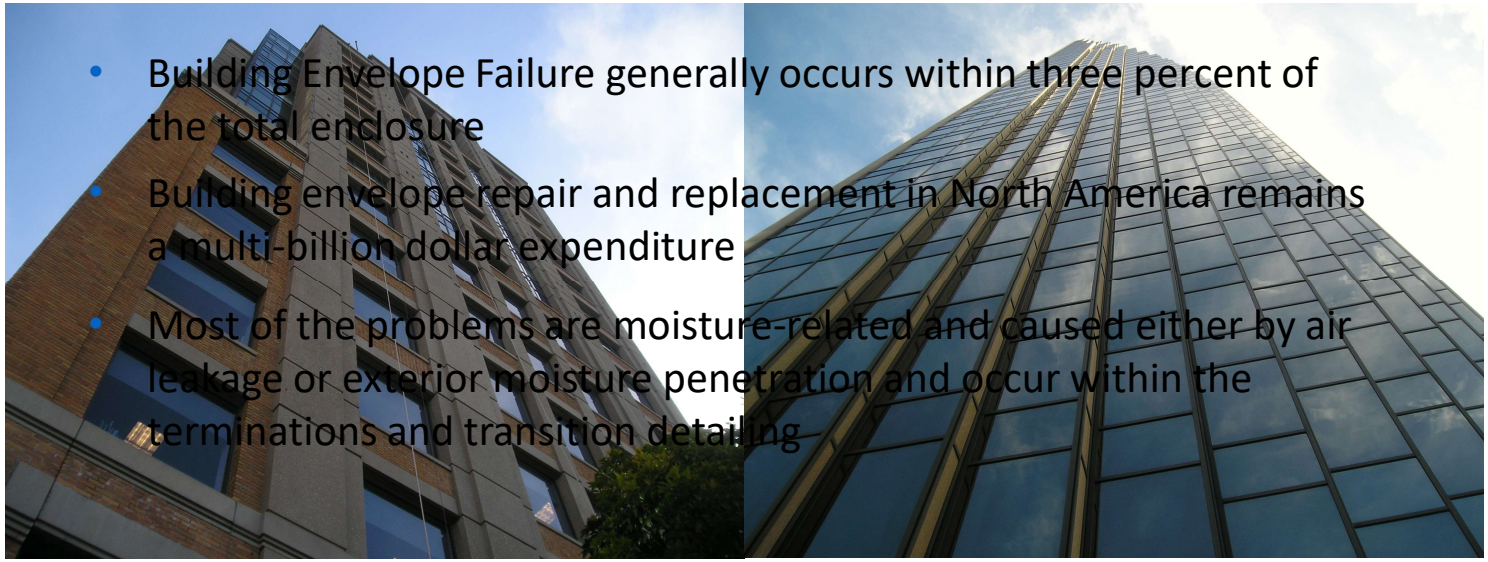


Marcy Tyler

Director of Building Science



Building Envelopes Today



- Building Envelope Failure generally occurs within three percent of the total enclosure
- Building envelope repair and replacement in North America remains a multi-billion dollar expenditure
- Most of the problems are moisture-related and caused either by air leakage or exterior moisture penetration and occur within the terminations and transition detailing

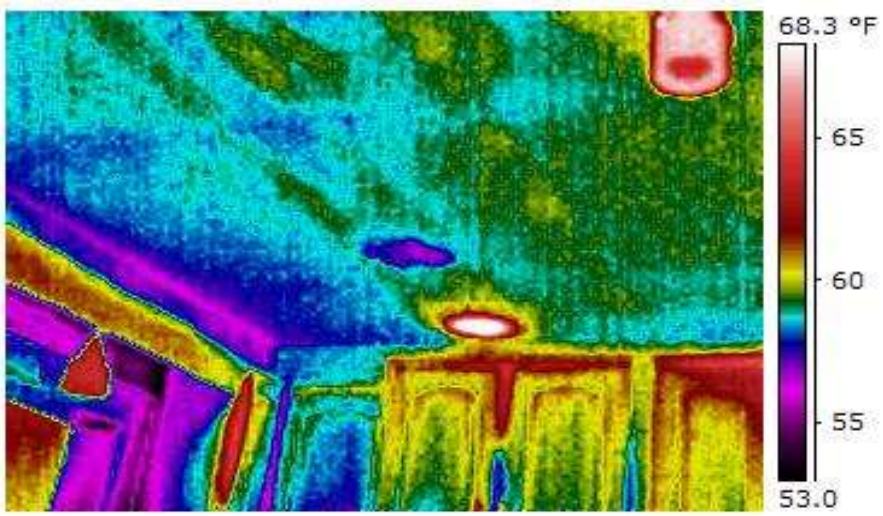
Lack of Performance

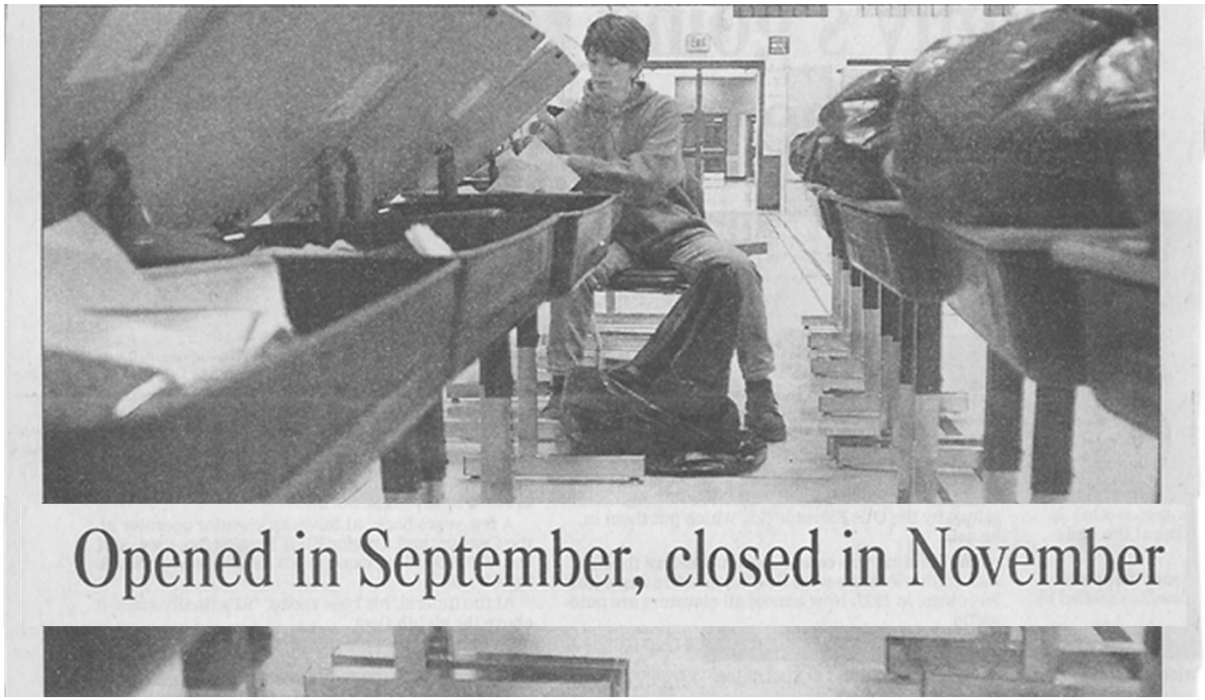
There is no single source of responsibility for:

- Quality control
- Spec enforcement
- Building envelope integrity
- Lowest price, technically acceptable
- **“BY OTHERS”**

Lack of Energy Efficiency

Moisture and energy leaks are common despite everything we know about the importance of a system approach to the building enclosure





Lack of Resiliency

- 90% of the time, it comes down to the transitions and terminations
- A failure in one component can and does affect other components in the building

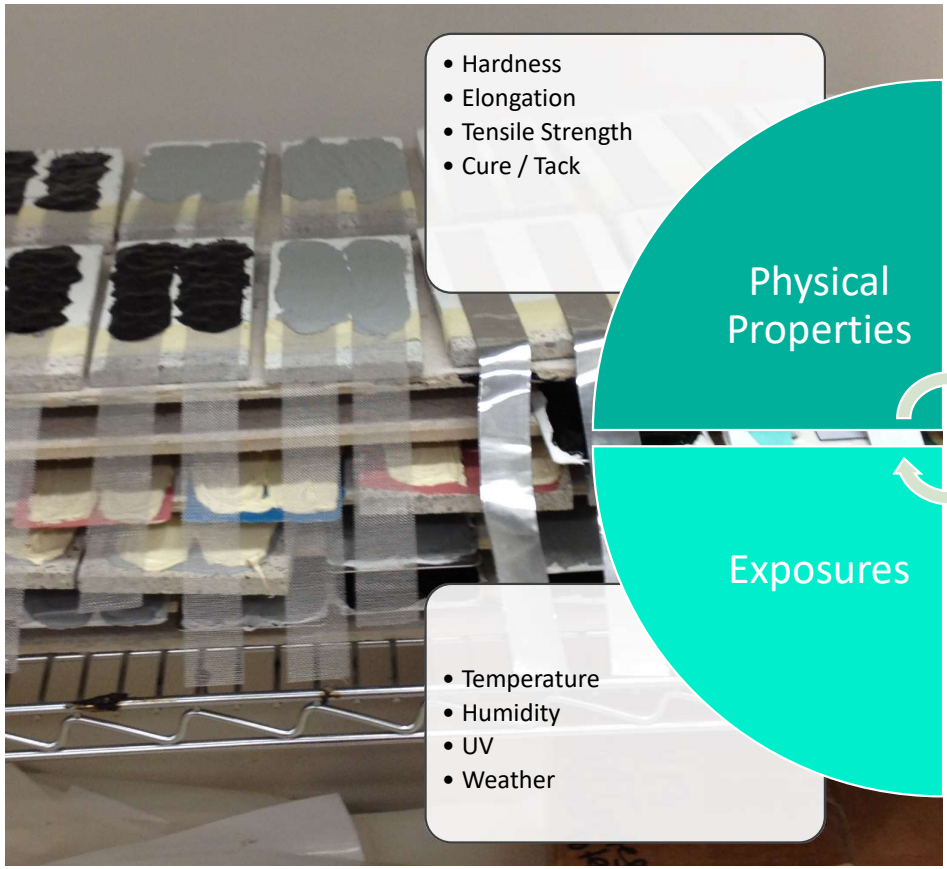
What Role Does Sealant Play?

- Protection: Air & Water Infiltration
- Thermal management
- Sound dampening
- Firestopping
- Dynamic joints
- Transitions
- Detailing
- Aesthetics

Learning Objectives

- Follow the path of sealant development to understand the importance of exposure and installation requirements
- Review performance testing of different chemistries and the part they play in sealant selection.
- Gain knowledge of a variety of questions that need to be answered to choose the right product for the right application
- Examine the importance of proper installation and how to troubleshoot potential issues

Sealant Journey



- Hardness
- Elongation
- Tensile Strength
- Cure / Tack

Physical Properties

Field Trials

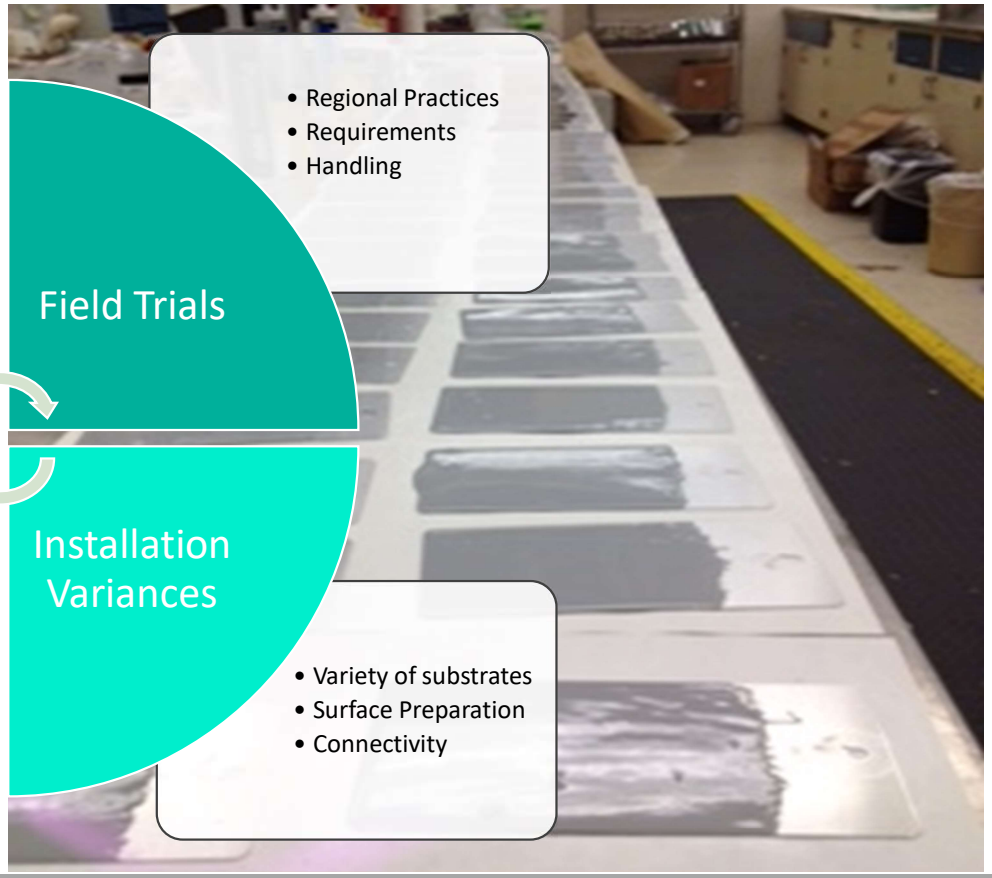
- Regional Practices
- Requirements
- Handling

Exposures

- Temperature
- Humidity
- UV
- Weather

Installation Variances

- Variety of substrates
- Surface Preparation
- Connectivity



Driving factors

- What does the specification (spec) requ
- What is the application?
- What are the substrates?
- What kind of movement is expected?
- Experienced applicator?
- Is Priming required?
- Will the sealant be painted?
- Warranty expectations?
- Color requirements?

Chemistry & Technology

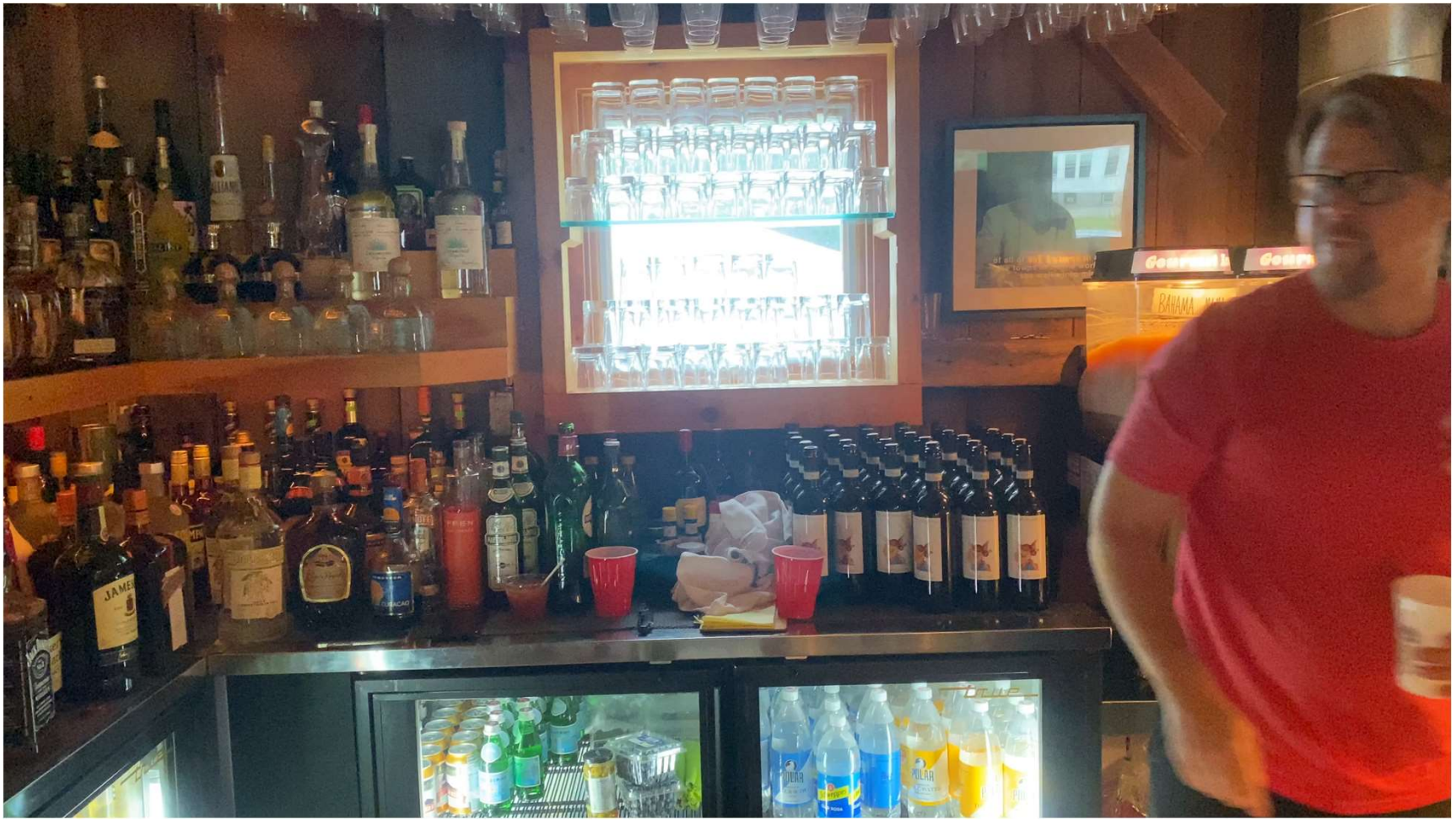
Silicones	Polyurethanes	Hybrids	Acrylics	Butyls
• Can't be coated over with anything but silicones • High temperature & UV resistance	• Can be coated over, but need to verify compatibility • Verify temperature and UV resistance	• Some can be coated over, but need to verify compatibility • Verify temperature and UV resistance	• Must be coated over, but may not provide the movement needed	• Non-skinning, no movement, should not be exposed

TREMCO

SEALANT SELECTION GUIDE

	Vulkem 116	Vulkem 45SSL	Dymonic 100	Vulkem 445SSL	Dymeric 240FC	THC 901	Dymonic FC	Spectrem 1	Spectrem 2	Spectrem 3	Spectrem 4-TS	Spectrem 800	Spectrem 900SL	Tremsil 200	Tremsil 600	Proglaze SSG	Proglaze II	Proglaze	Tremflex 834	Butyl Sealant	Acoustical Sealant	Tremco 830	Willseal 601**
Chemistry	U	U	U	U	U	U	H	S	S	S	S	S	S	S	S	S	S	S	A	B	B	T	PT
Non-Sag or Pourable	NS	P	NS	P	NS	P	NS	NS	NS	NS	NS	NS	P	NS	NS	NS	NS	NS	NS	NS	NS	NS	0
Single- or Multi-Component	S	S	S	M	M	M	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S	S	0
SWRI			Yes					Yes	Yes														
GREENGUARD Gold			Yes		Yes		Yes	Yes	Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes				Yes
Movement Capability	± 25%	+100/ -50%*	+100/ -50%*	+100/ -50%*	± 50%*	± 25%	± 35%	+100/ -50%	± 50%	± 50%*	± 50%*	+100/ -50%	+100/ -50%	± 25%	± 25%	± 25%	± 25%	± 25%	± 12.5%	Up to ± 10%		± 12.5%	
MASONRY																							
Poured Concrete	●	●	●	●	●	●	●	●	●	●	●	●	●		●					●			●
Cast-in-Place/ Tilt-Up	●		●		●	●	●	●	●	●	●	●	●		●					●			●
CMU Block	●		●		●		●	●	●	●	●				●					●			●
Brick	●	●	●	●	●	●	●	●	●	●	●				●					●			●
Natural Stone	●	●	●	●	●	●	●	●	●	●	●				●								●
Stucco	●		●		●		●			●	●												●
Reservoir†	●		●																				
METALS																							
Curtain Walls			●		●		●	●	●	●	●	●			●						●		
Flashing	●		●		●		●	●	●						●					●		●	
Sidings	●		●		●		●	●	●						●				●	●		●	
Window and Door Perimeters	●		●		●		●	●	●	●	●	●			●				●			●	●
DRYVIT®/EIF SYSTEMS					●		●	●		●	●												●
VINYL AND PLASTICS	●		●		●		●	●	●						●				●			●	●

	Vulkem 116	Vulkem 45SSL	Dymonic 100	Vulkem 445SSL	Dymeric 240FC	THC 901	Dymonic FC	Spectrem 1	Spectrem 2	Spectrem 3	Spectrem 4-TS	Spectrem 800	Spectrem 900SL	Tremsil 200	Tremsil 600	Proglaze SSG	Proglaze II	Proglaze	Tremflex 834	Butyl Sealant	Acoustical Sealant	Tremco 830	Willse
Chemistry	U	U	U	U	U	U	H	S	S	S	S	S	S	S	S	S	S	S	A	B	B	T	PT
Non-Sag or Pourable	NS	P	NS	P	NS	P	NS	NS	NS	NS	NS	NS	P	NS	NS	NS	NS	NS	NS	NS	NS	NS	0
Single- or Multi-Component	S	S	S	M	M	M	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S	S	0
SWRI			Yes					Yes	Yes														
GREENGUARD Gold			Yes		Yes		Yes	Yes	Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes				Yes
Movement Capability	± 25%	+100/ -50%*	+100/ -50%*	+100/ -50%*	± 50%*	± 25%	± 35%	+100/ -50%	± 50%	± 50%*	± 50%*	+100/ -50%	+100/ -50%	± 25%	± 25%	± 25%	± 25%	± 25%	± 12.5%	Up to ± 10%		± 12.5%	
GREEN AND DAMP CONCRETE		●	●	●																			●
GLASS								●	●					●	●	●	●	●		●		●	
WOOD	●	●	●	●	●	●	●	●	●	●	●				●				●	●	●	●	●
DRYWALL (GYPSUM)/METAL STUD PARTITION																			●		●		●
GENERAL GLAZING																							
Toe Bead								●	●					●	●								
Heel Bead								●	●					●	●								
Cap Bead								●	●					●	●		●					●	
Weather Seal	●		●		●		●	●	●	●	●			●					●				
Bedding							●		●					●			●	●	●			●	
STRUCTURAL GLAZING																							
Tensile Bead 2-Sided									●						●	●							
Tensile Bead 4-Sided															●	●							
PROTECTIVE GLAZING																							
Hurricane/ Impact									●						●	●							
Bomb Blast									●						●	●							
Tub and Tile/ Sanitary														●									
Jet Fuel Resistance	●	●	●	●									●										


JAME
CURACAO
POLAR
POLAR
BAHAMA

Chemistry & Technology - Immersion

Silicones	Polyurethanes	Hybrids	Acrylics	Butyls


ORIG NAL

Jobsite Conditions

Chemistry & Technology – Temperature (HOT)

Silicones	Polyurethanes	Hybrids	Acrylics	Butyls

Chemistry & Technology – Temperature (COLD)

Silicones	Polyurethanes	Hybrids	Acrylics	Butyls

Chemistry & Technology – Sound Transmission

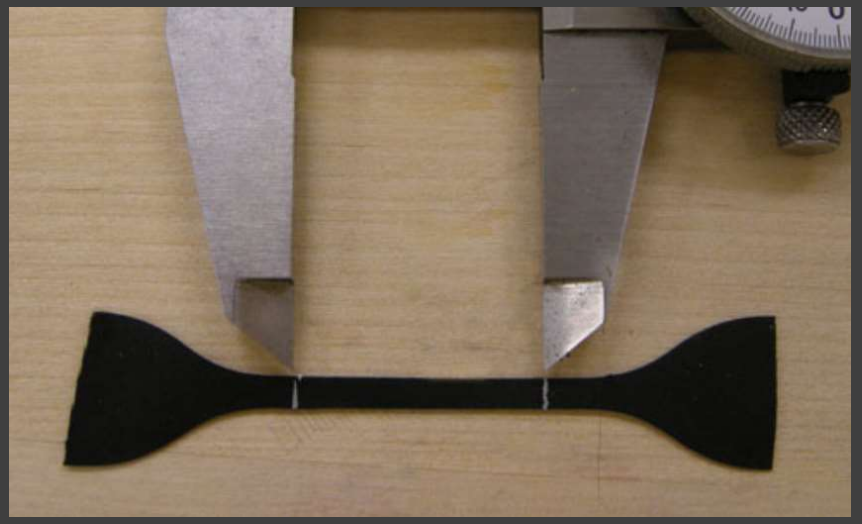
Silicones	Polyurethanes	Hybrids	Acrylics	Butyls

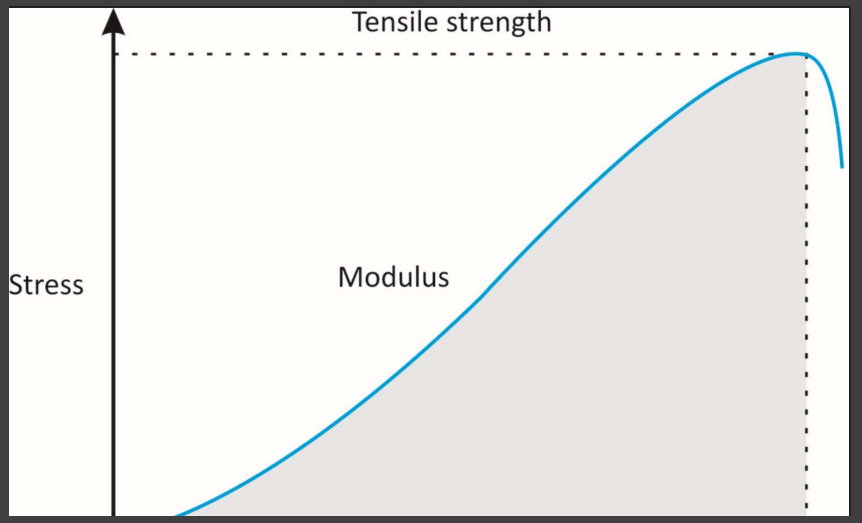

What about movement?

Modulus of Elasticity

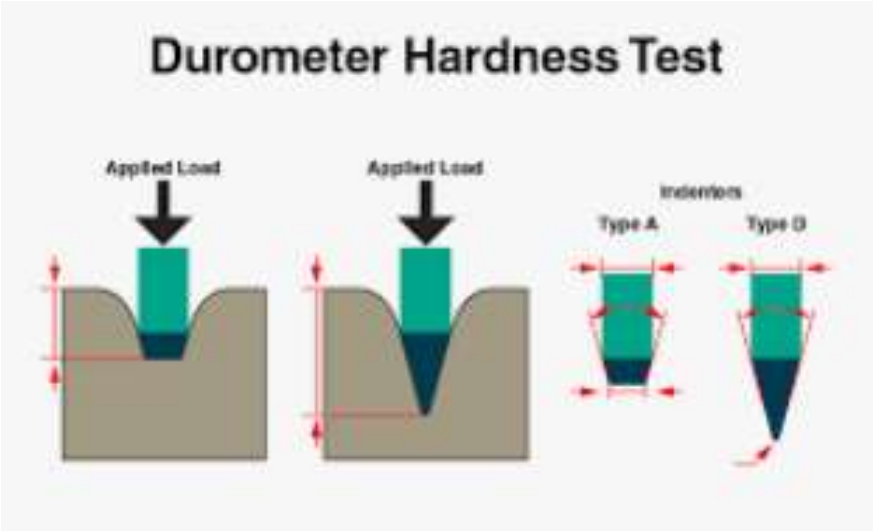
Ratio of stress vs strain (elongation)

- Low modulus: high movement
- Medium modulus: medium movement, two sided structural, metal panels, general purpose
- High modulus: low movement





Sealant Performance Testing



Sealant Performance Testing

Sealant Performance Testing

Chemistry & Technology – Movement

Silicones	Polyurethanes	Hybrids	Acrylics	Butyls

Adhesion & Compatibility

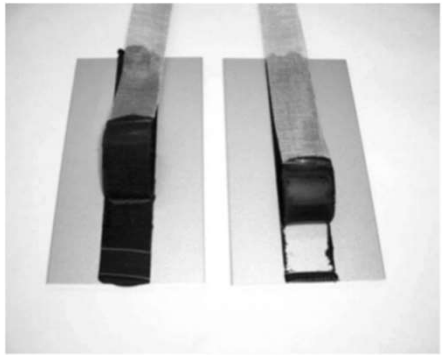
- Materials are considered compatible when objects that come into contact with each other exhibit neither adverse reactions nor loss of performance properties.
  - Incompatibility can result in staining, streaking, damage to substrate, etc.

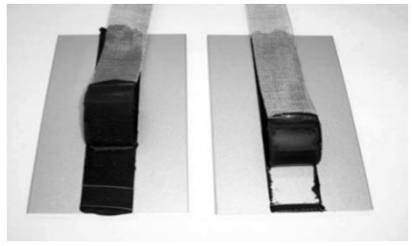
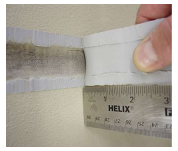
- Adhesion is defined as the process of attachment of a substance to the surface of another substance.

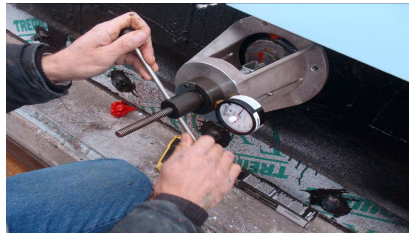
- A sealant may be compatible with a specific substrate, but may not adhere to the substrate.

Adhesion








Chemistry & Technology – Adhesion

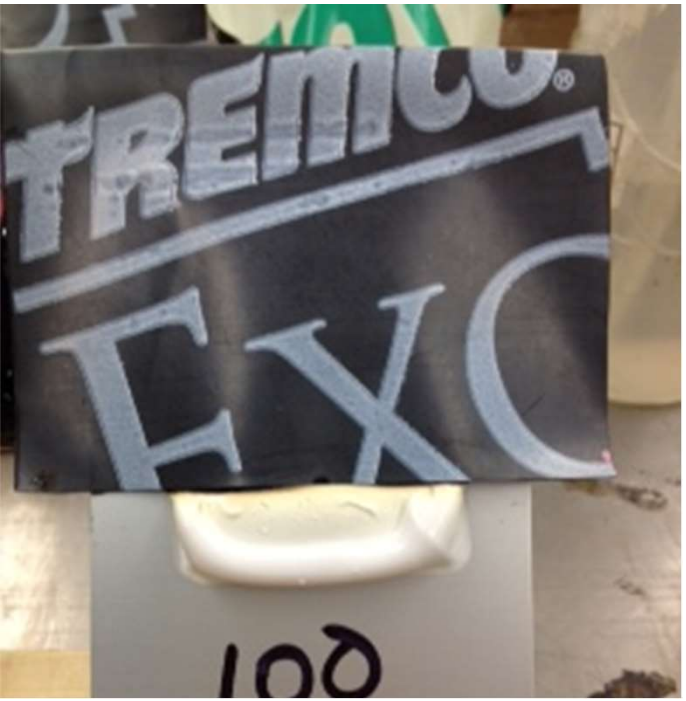
Silicones	Polyurethanes	Hybrids	Acrylics	Butyls

Chemistry & Technology – Adhesion to Cured Surface

Silicones	Polyurethanes	Hybrids	Acrylics	Butyls
If its another silicone				


HORIZON

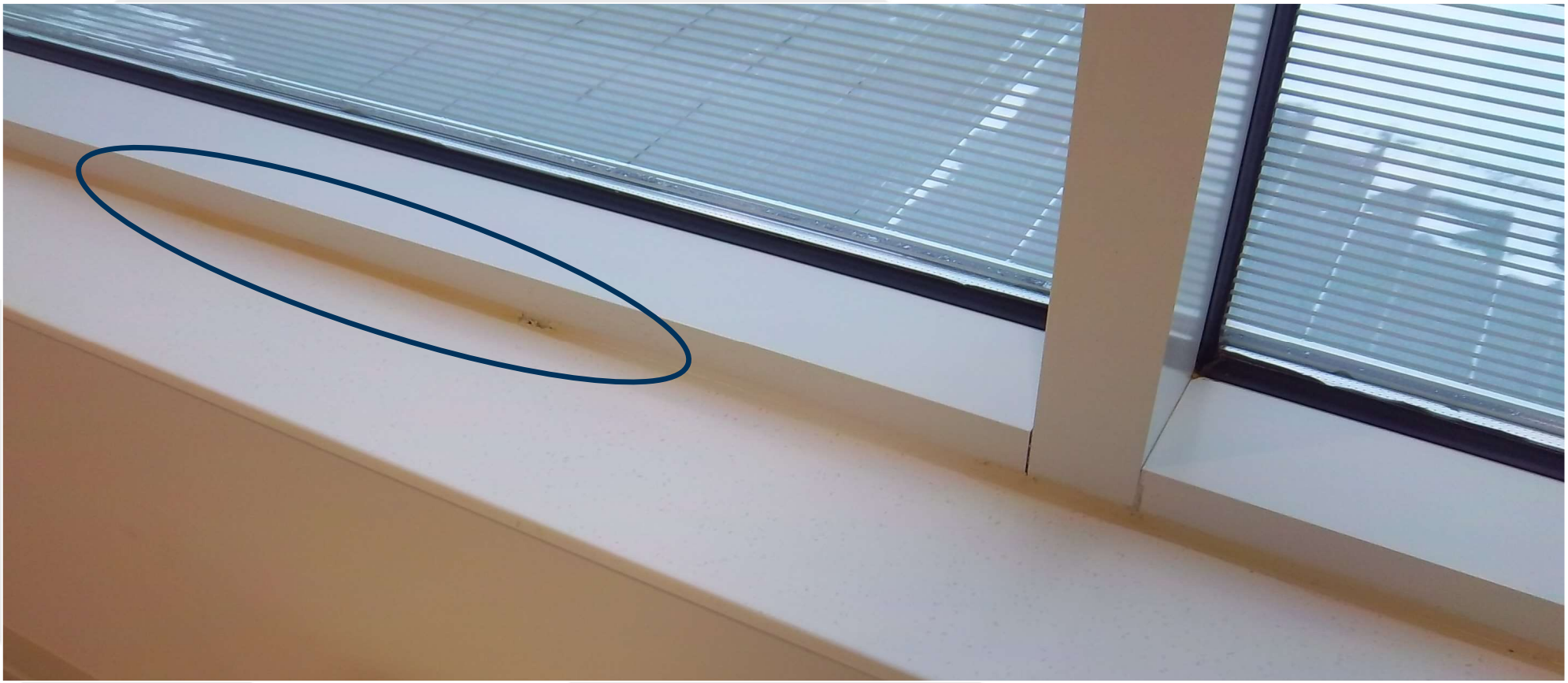
Compatible?



Compatibility

- The compatibility of two or more compounds or substances to be placed in contact or close proximity to one another without detrimental effects on either
- Compatibility does not guarantee good adhesion

Compatibility







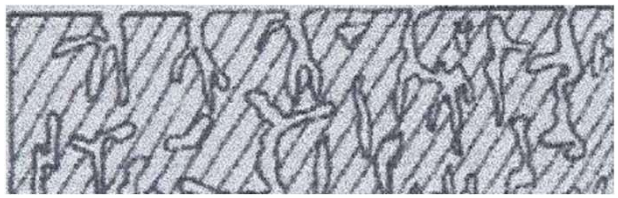

Silicone Staining Problems Were Identified in the Late 80's and Early 90's

- Fluid Migration / Streaking
- Plasticizer Migration
- Dirt or Residue
- Hydrophobic Bloom


Stone Characteristics that Impact Stain Potential of a Sealant

- Porosity
- Permeability
- Absorbency
- Chemical (Metal) Content
- Finish – Polished or Flamed Stone

STONE ABSORBENCY RANGES			
Granite	0.2 – 0.5	Slate	0.1 – 1.7
Marble	0.2 – 0.6	Limestone	0.2 – 9.0
Quartzite	0.1 – 1.4	Sandstone	0.2 – 12.0



Porosity Ratios %			
Granite	0.4 – 1.5	Slate	0.4 – 5.0
Marble	0.5 – 2.0	Limestone	0.6 – 31.0
Quartzite	0.4 – 3.9	Sandstone	0.5 – 35.0

Advances in Reducing Staining Potential

- Larger molecular weight fluids and plasticizers
- Larger size molecules do not fit into stone pores as easily
- Formulation changes to improve cure rate and reduce free silicone levels
- Reduced polarity on the sealant surface

Standard Industry Test Stain Potential of Porous Substrates – ASTM C1248

- Test Duration = Approx. 2 months
- Evaluates effect of heat, UV and compression on the sealant and the substrate
- Compared against standard conditions
- Effects observed include substrate discoloration, and change in surface appearance
- Destructive analysis to determine if staining within substrate
- Measurement is taken of stain width and depth

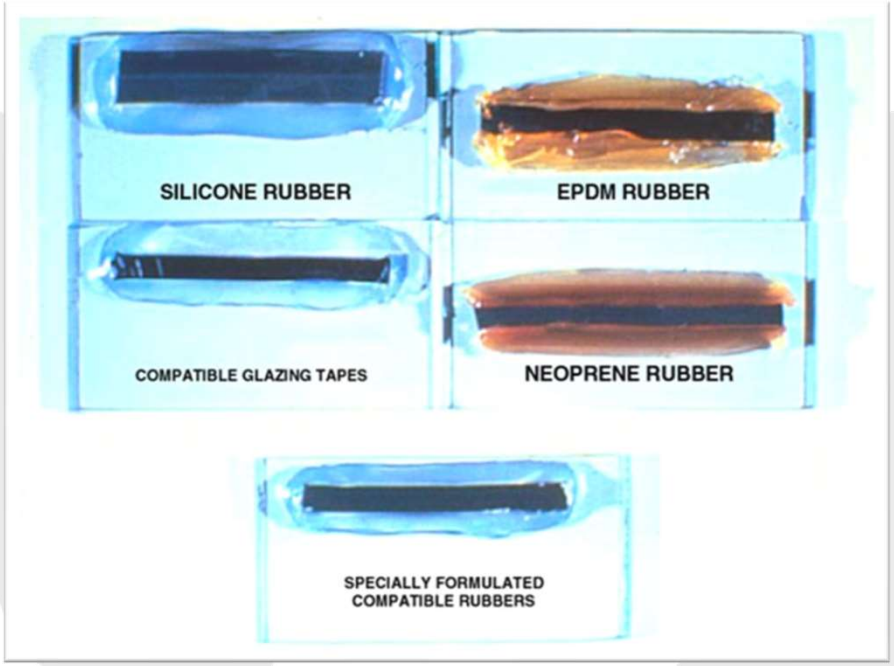
Staining on White Marble

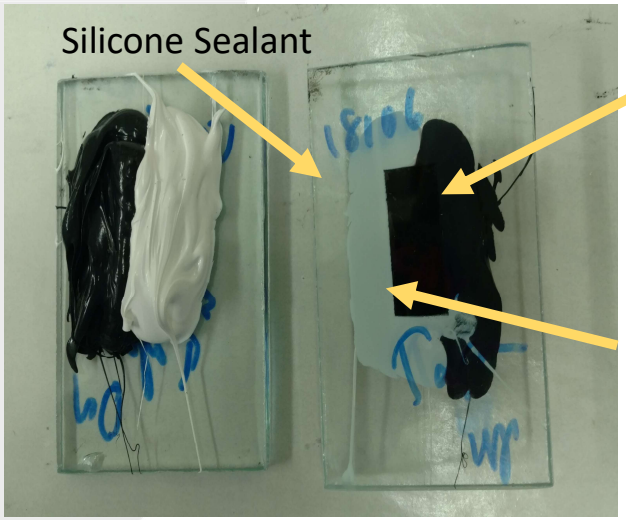
ASTM C1248

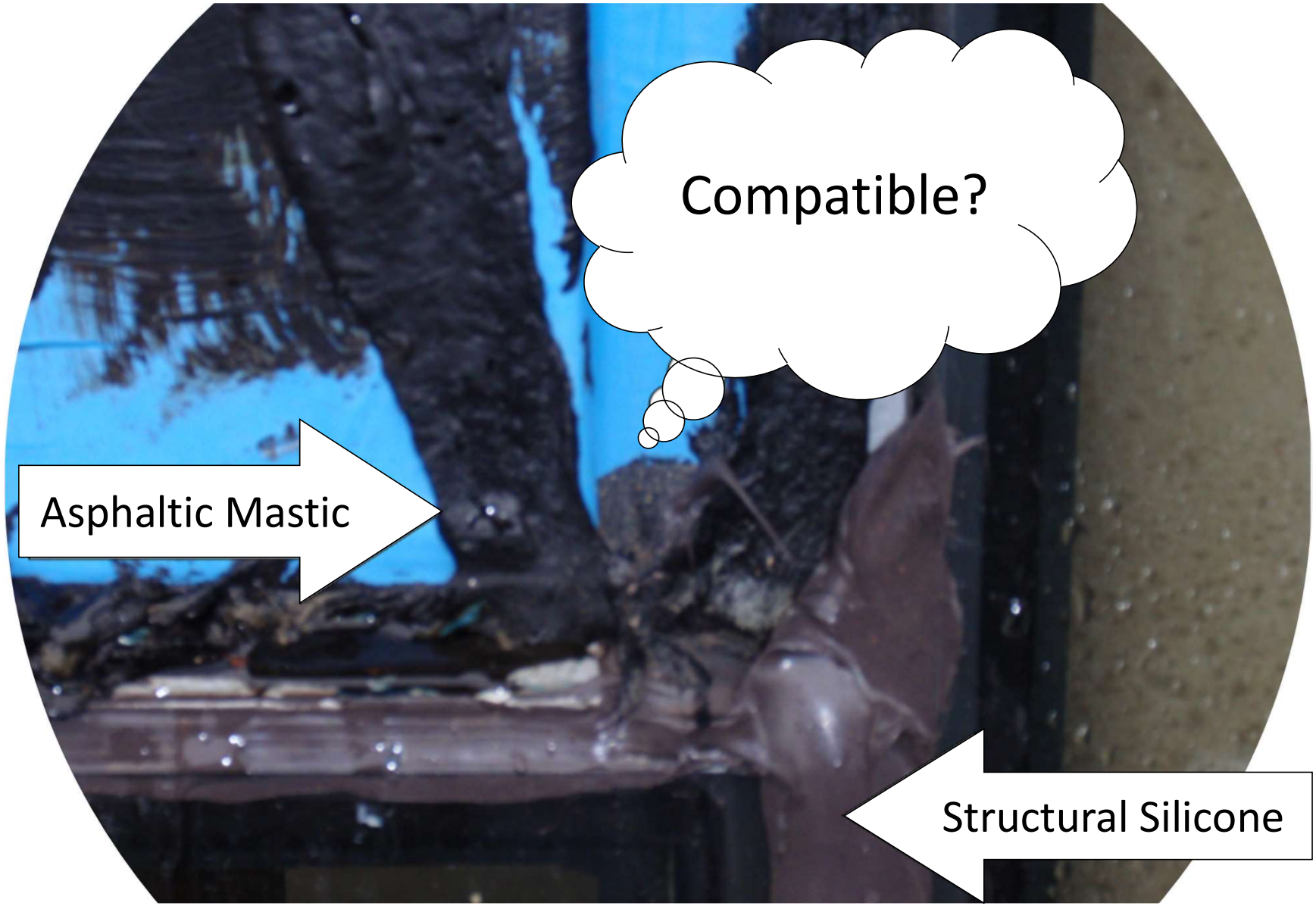
- Assembly samples
- Allow for full cure
- Compress samples
  - Room temperature
  - 158F
  - UV Box
- Evaluate after 14 Days
- Evaluate after an additional 14 Days

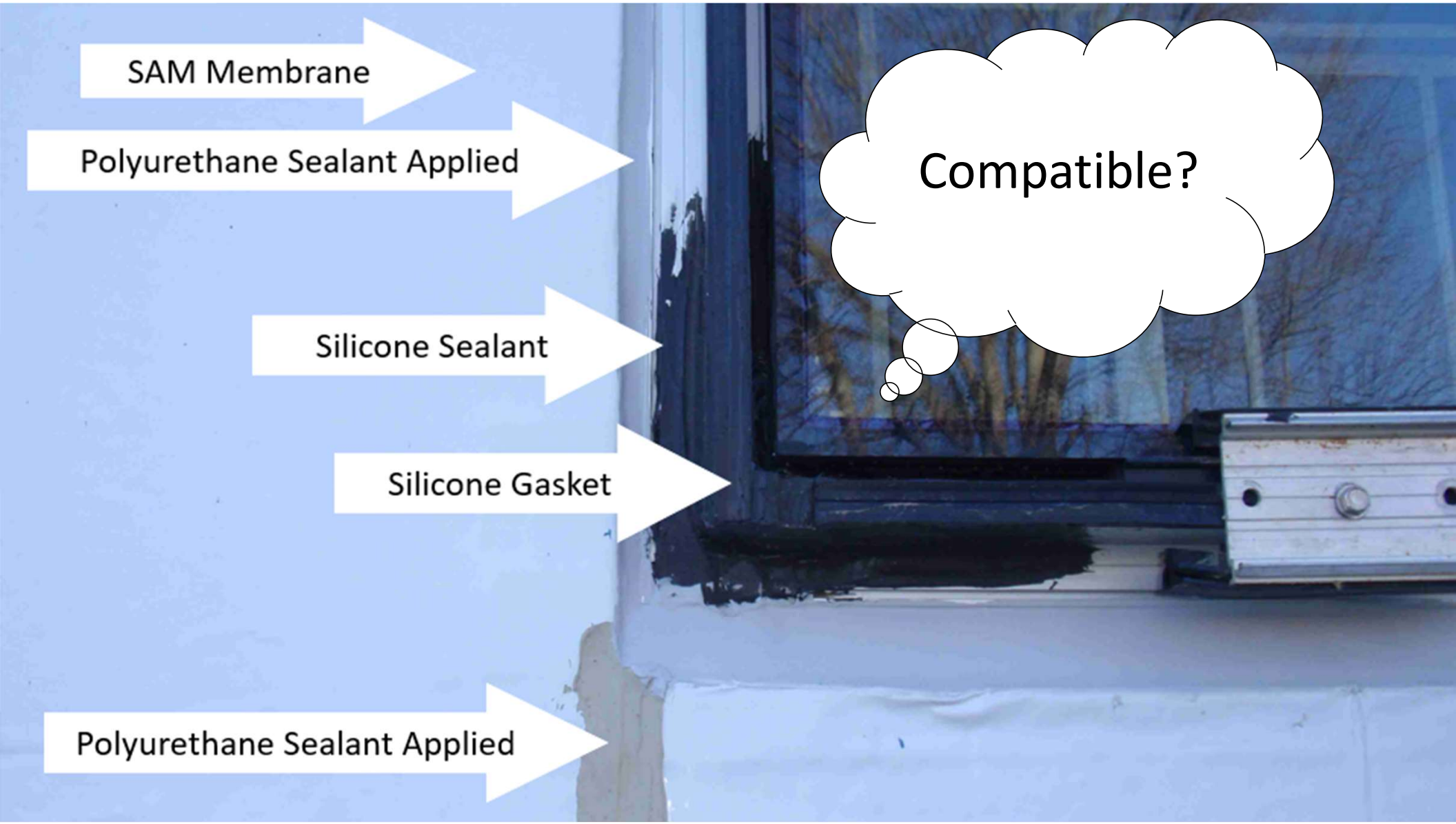
Sealant Performance Testing

- Standard Test Method For Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems






Compatible?
Asphaltic Mastic
Structural Silicone

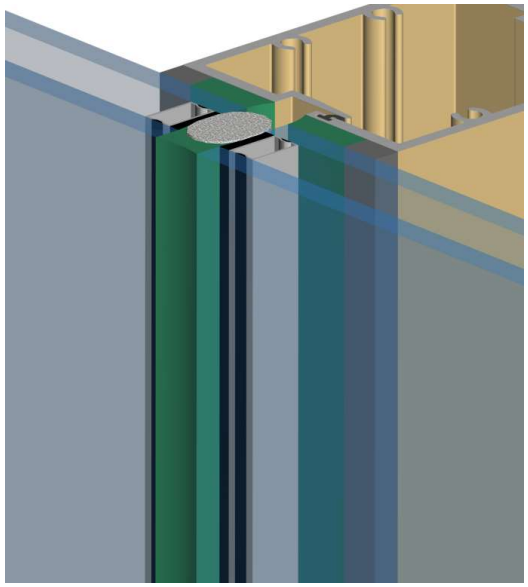

SAM Membrane
Polyurethane Sealant Applied
Compatible?
Silicone Sealant
Silicone Gasket
Polyurethane Sealant Applied

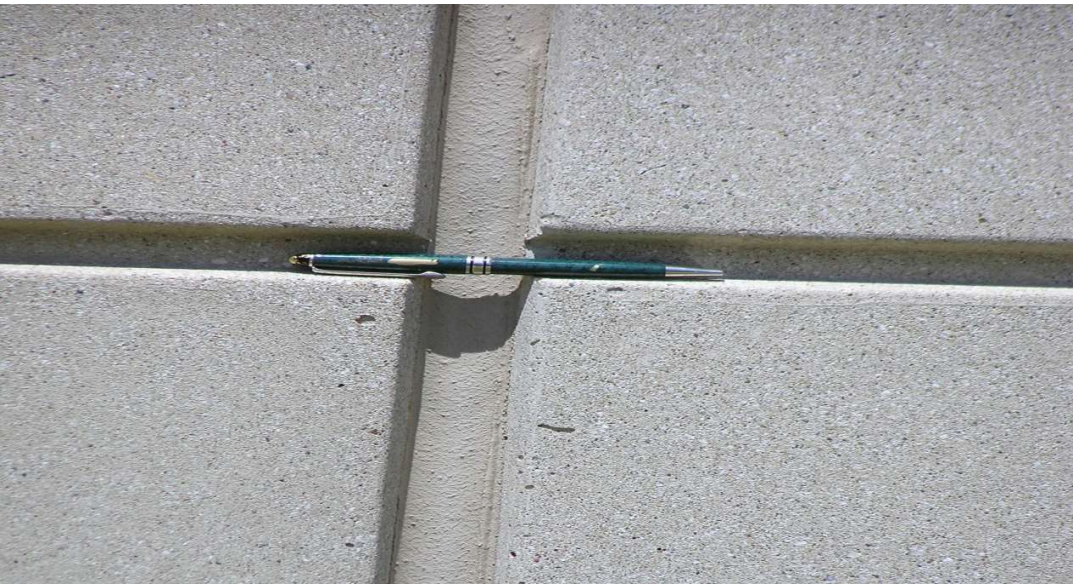
Chemistry & Technology – Compatibility

Silicones	Polyurethanes	Hybrids	Acrylics	Butyls

Silicone Sealant

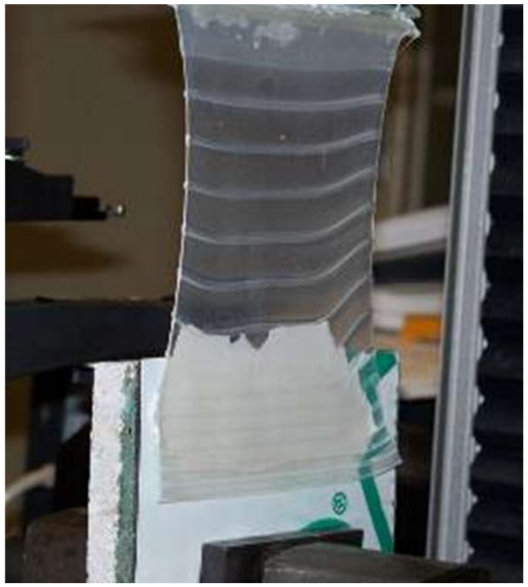
- Excellent resistance to UV light, ozone and moisture
- Superior color retention
- Heat and weathering capability
- Long term sustainability in vertical applications
- Neutral Cure makes them compatible with most substrates and insulating glass (IG) units
- Evolving technologies – field-tintable, multi-component, increased color selections, matte finishes, non-staining

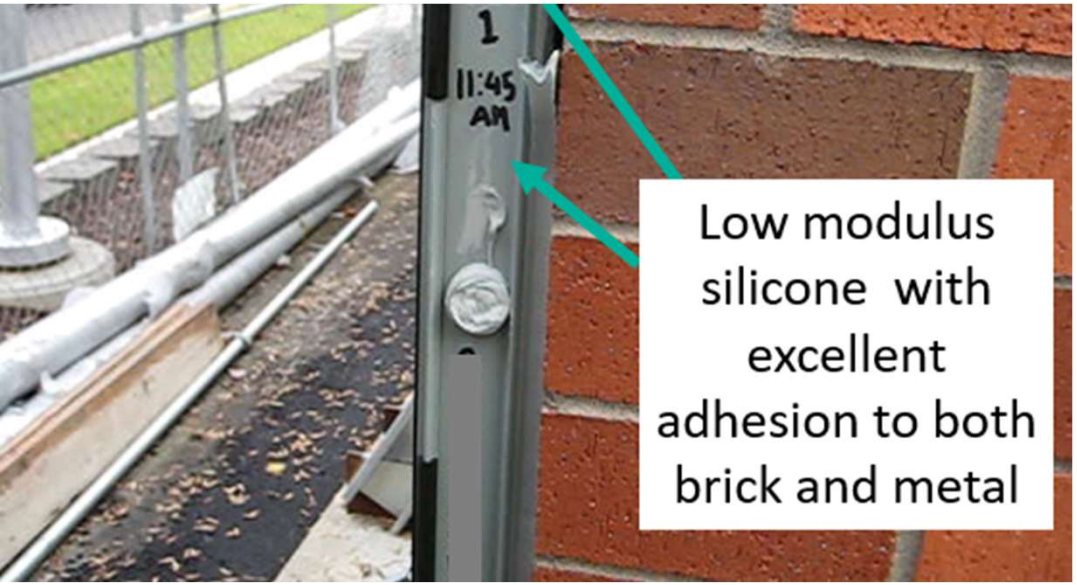




Silicone Applications

- Glazing (structural & perimeter)
- Typical construction joint applications
  - Masonry, precast, window perimeters
- Metal panels
- EIFS
- Re-caulking
- Used in conjunction with air & vapor barrier systems





Low-Modulus Silicones

- +100/-50%
- Suitable for dynamic moving joints
- Lower bond line stress
- Best for EIFS applications
- Primerless adhesion to wide range of substrates

Medium Modulus Silicones

- Neutral cure: compatibility for glazing applications and general purpose use
- +/- 50% movement capabilities / Class 50
- Type S
- Grade NS
- Use NT
- Applications
  - Weather seals
  - Window Perimeters
  - Approved for structural glazing (2sided)
  - Impact Resistant
  - Blast Mitigation

Polyurethanes

- Low Modulus
- Excellent movement capability
- Excellent unprimed adhesion
- *Excellent unprimed adhesion to green concrete!*
- Wide range of standard color and custom
- Excellent for dynamic joints
- Paintable
- Robust structure – accepts traffic
- Non-staining
- Tenacious adhesion
- Immersed conditions (sealant-dependent)

Silicone, Polyurethane, Hybrid Sealants

- Expansion & Control Joints
- Precast panels, natural stone,
- Masonry, concrete, EIFS
- Store Front
- Perimeter joints
- Detail work for waterproofing
- Firestopping for joints

Silicone, Polyurethane, Hybrid Sealant

- Class 25, Type S
- Grade NS, Use NT
- Applications
  - Window perimeters
  - Control joints

Multi-Component Polyurethane

- Class 50, Type M
- Grade NS
- Use T, NT and I
- Applications
  - Immersed Conditions

Polyurethane Sealant

- Class 25, Type M
- Grade P
- Use T
- Concrete Paving
- Parking Structures
- Green Concrete

Acrylic Sealants

- ASTM C 834
- Movement 12 ½%
- Flame Spread – 10
- Smoke Development -0
- Paintable
- Interior Acoustical Seal
- Detail for air barrier systems

Butyl Sealants

- Metal Panel Joinery
- Bedding thresholds
- Secondary glazing seal
- Movement - 10%

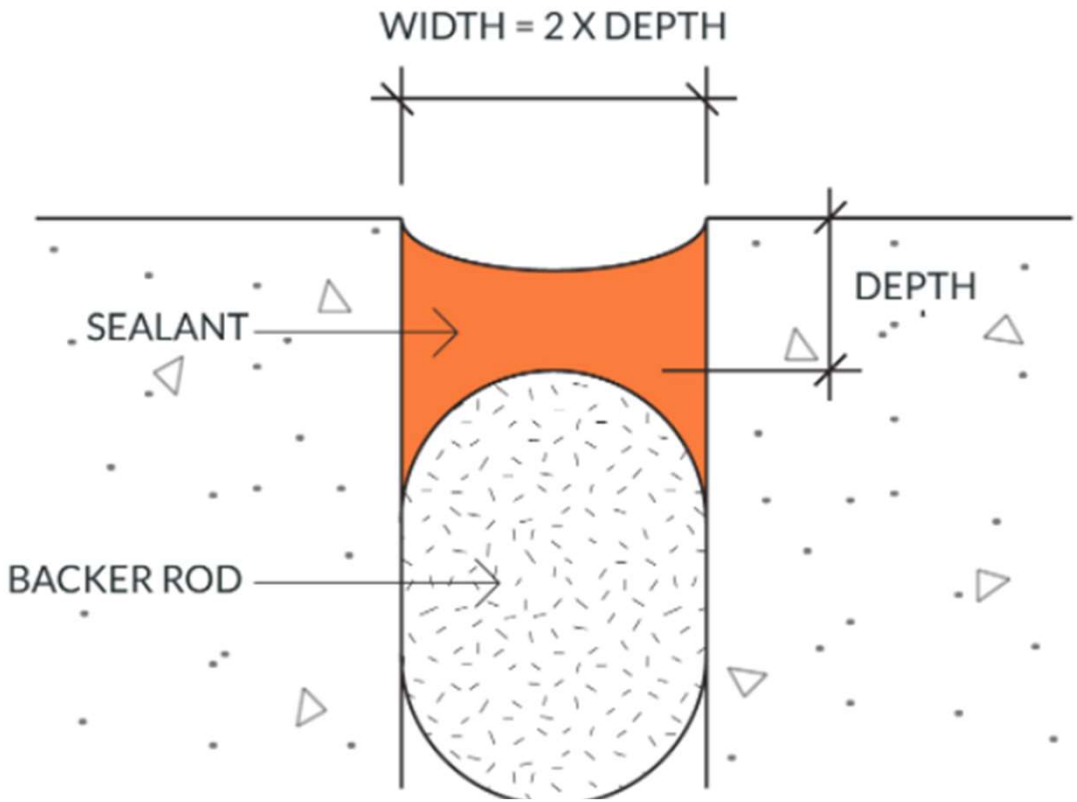
Case Study

- Polyurethane sealant
- Installation:
  - Early fall
  - 45-60F
  - Sunny
- Horizontal, vertical, parking lot, stadium, window perimeters, expansion joints
- 153 samples evaluated

Case Study

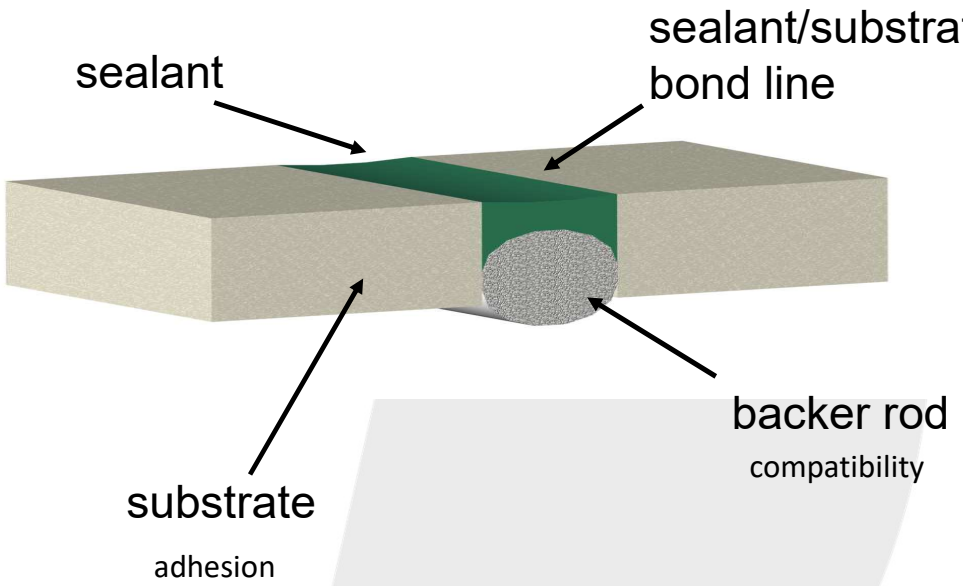
- 63: lack of or improper installation of backer support
- 32: debris on bond line
- 27: width to depth (thin)
- 16: width to depth (deep)
- 8: lack of tooling
- 7: Different chemistry

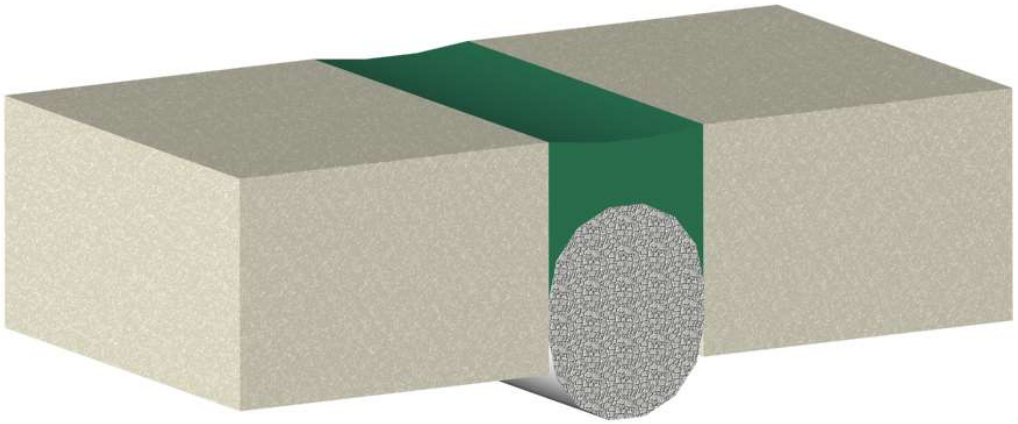
Sealant Configuration

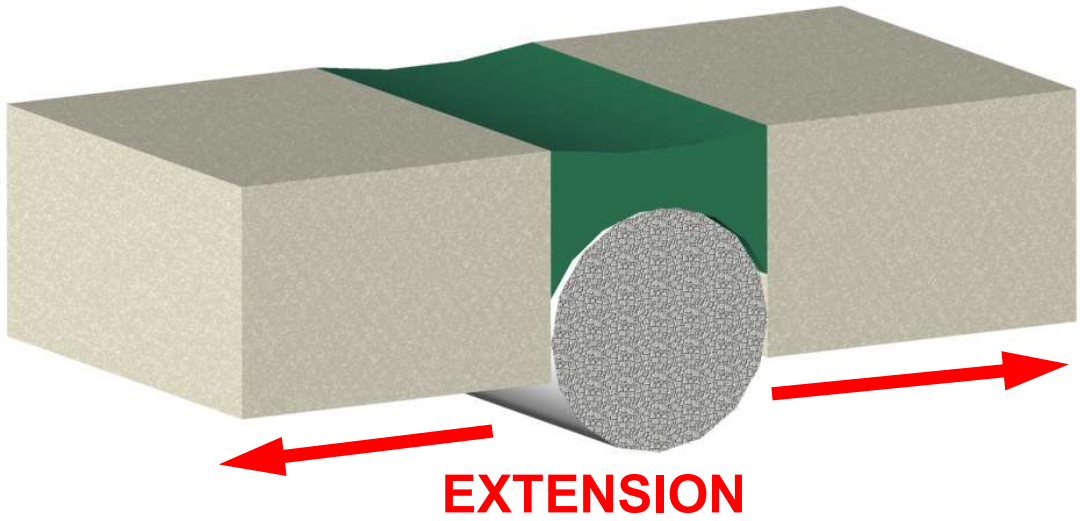


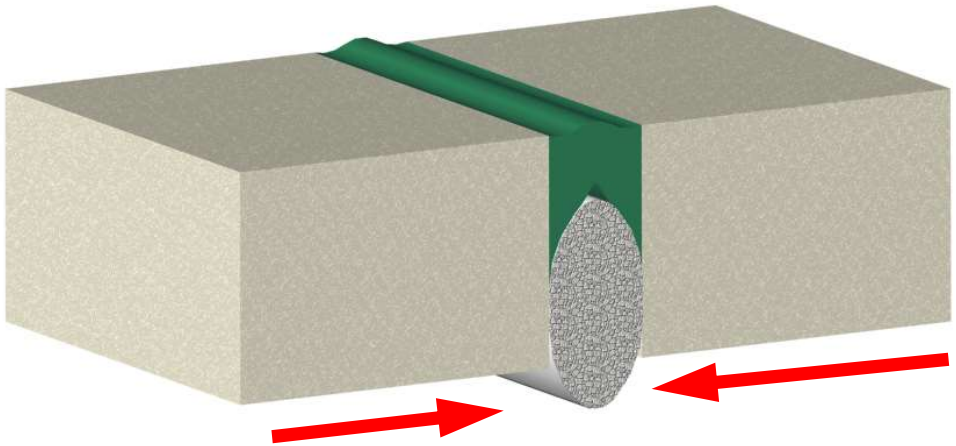
Sealant Configuration

- Why use a backer rod?
  - Control of joint depth
  - Prevent three-sided adhesion
  - Support tooling
  - Promote hourglass bead shape
- Types of backer rod
  - **Closed cell:** Resists air/moisture permeation
    - Cures from outside (single side)
    - Used in most applications
  - **Open cell:**
    - Allows air/moisture permeation
    - Curing from outside and inside (two sides)
    - Used in encapsulated or dry application


sealant
sealant/substrate
bond line
backer rod
compatibility
substrate
adhesion

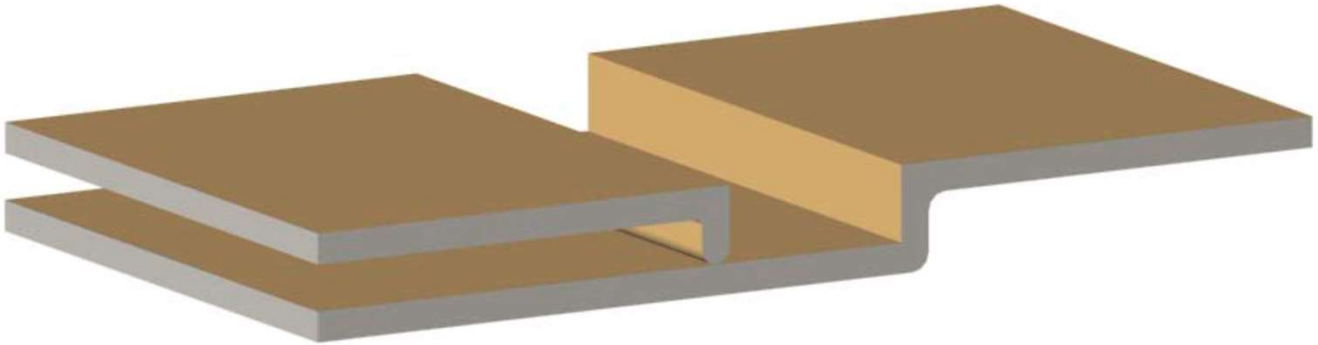



EXTENSION



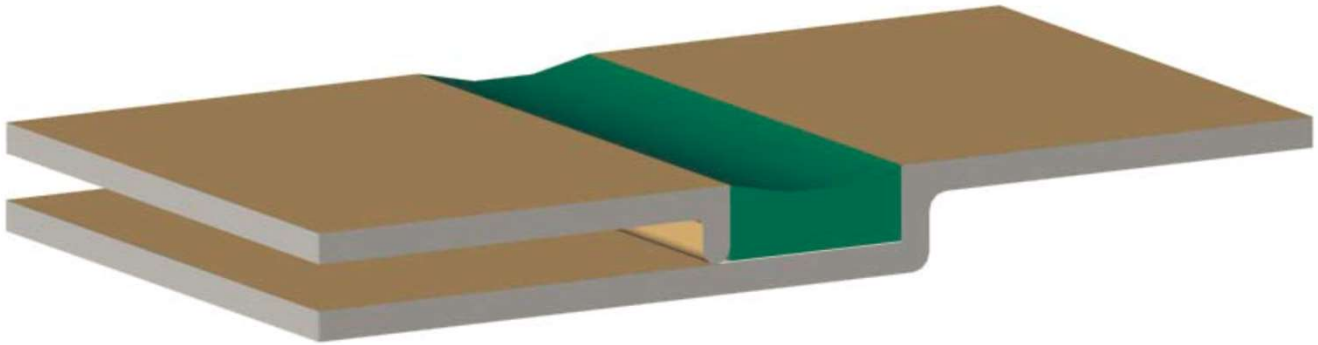
COMPRESSION

Three-Sided Adhesion



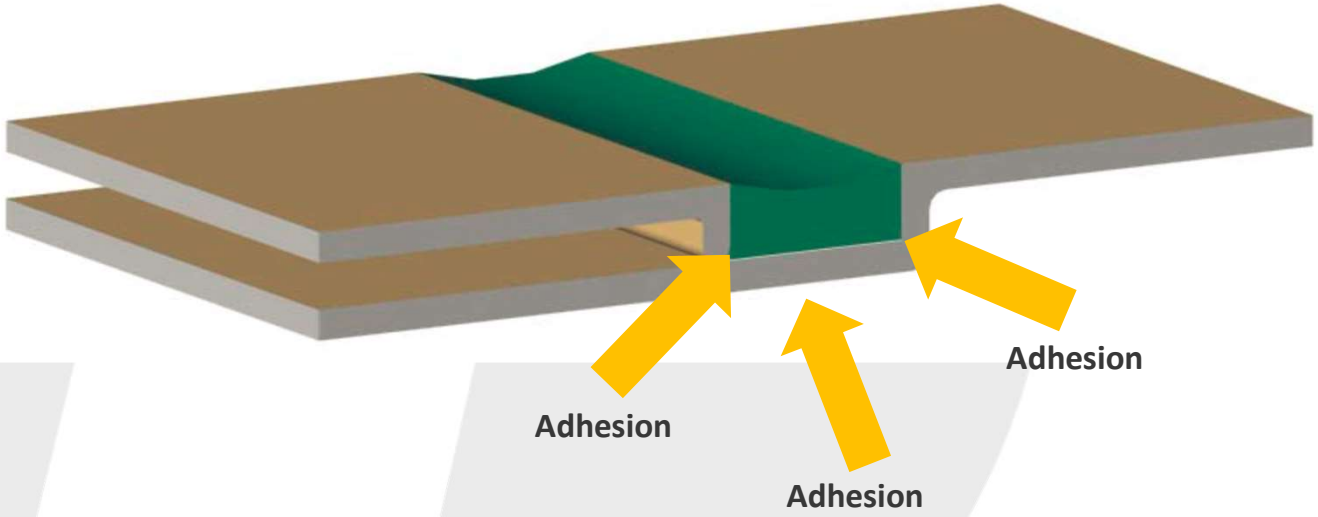
Typical metal-to-metal joint

Three-Sided Adhesion



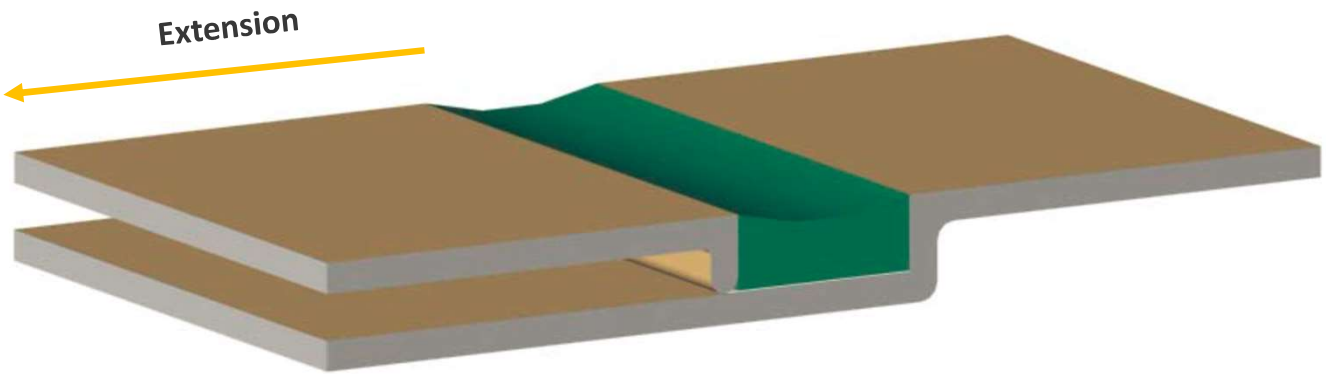
Sealant applied and tooled

Three-Sided Adhesion



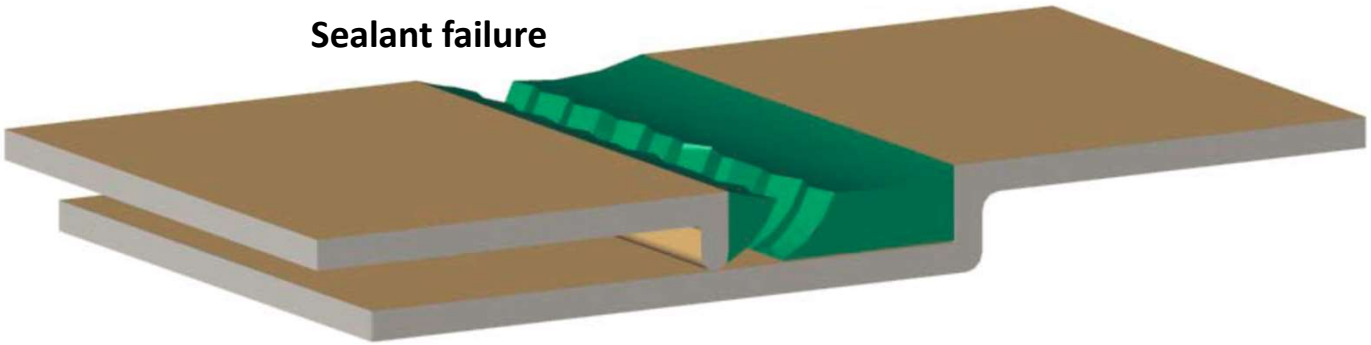
Adhesion is developed on three surfaces

Three-Sided Adhesion



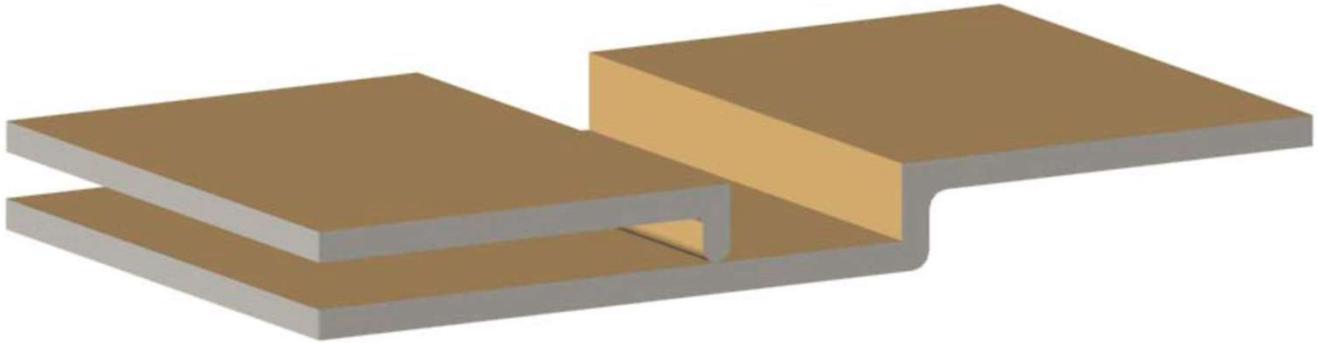
Joint extension occurs

Three-Sided Adhesion



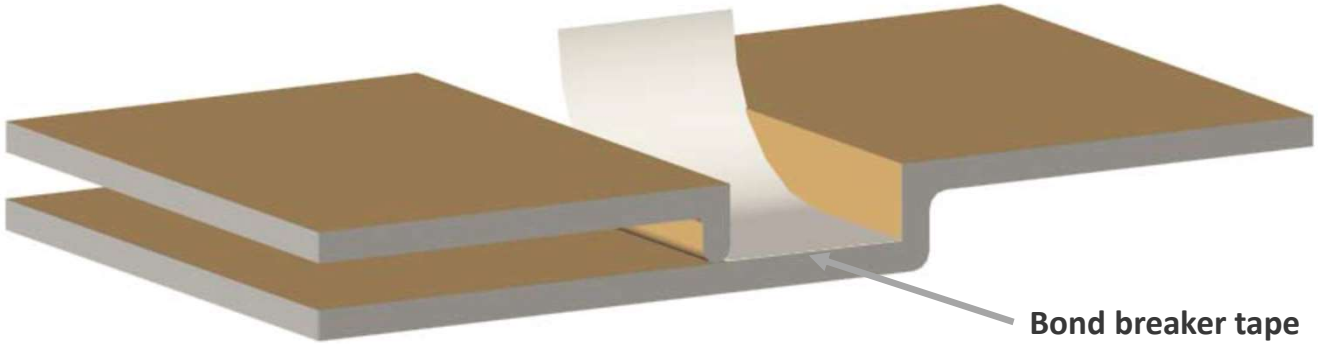
Under extension additional stress tears sealant

Three-Sided Adhesion - Prevention



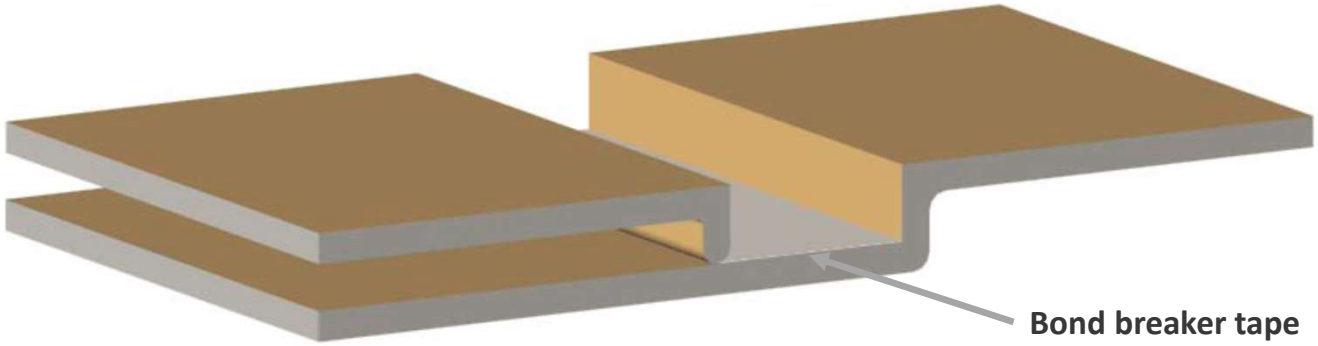
Typical metal-to-metal joint

Three-Sided Adhesion - Prevention



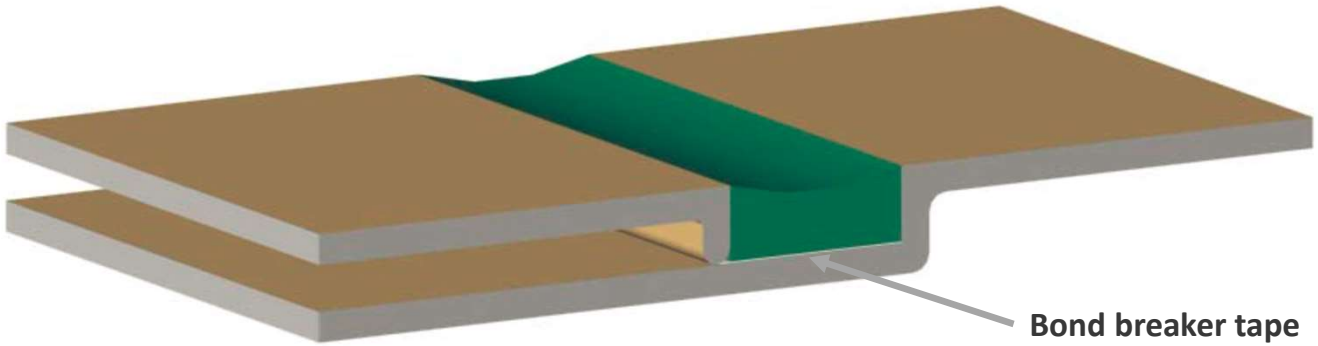
Bond breaker tape applied in joint (at one surface)

Three-Sided Adhesion - Prevention



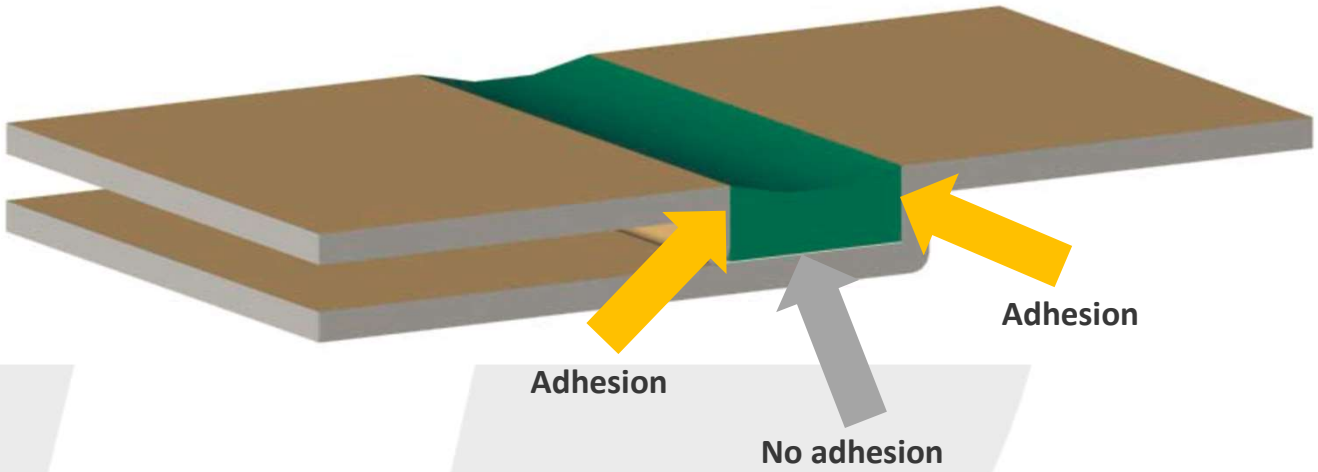
Bond breaker tape applied in joint (at one surface)

Three-Sided Adhesion - Prevention



Sealant applied and tooled

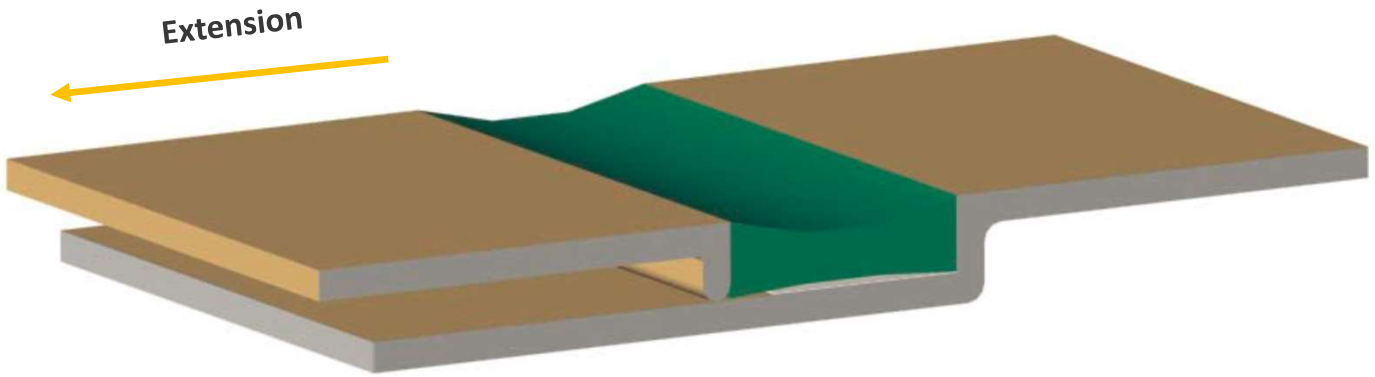
Three-Sided Adhesion - Prevention



Adhesion is developed on two surfaces

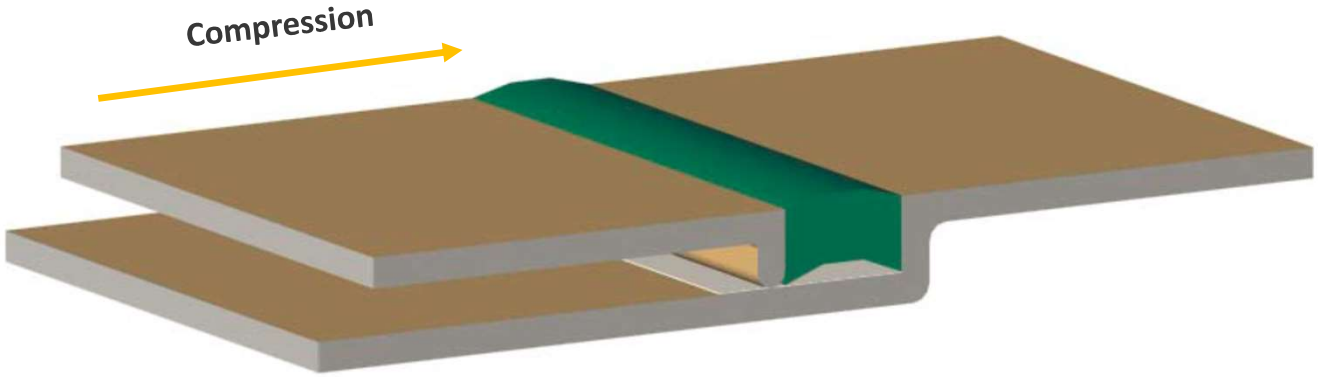
Adhesion is prevented by bond breaker tape on third surface

Three-Sided Adhesion - Prevention



Sealant can now perform under extension

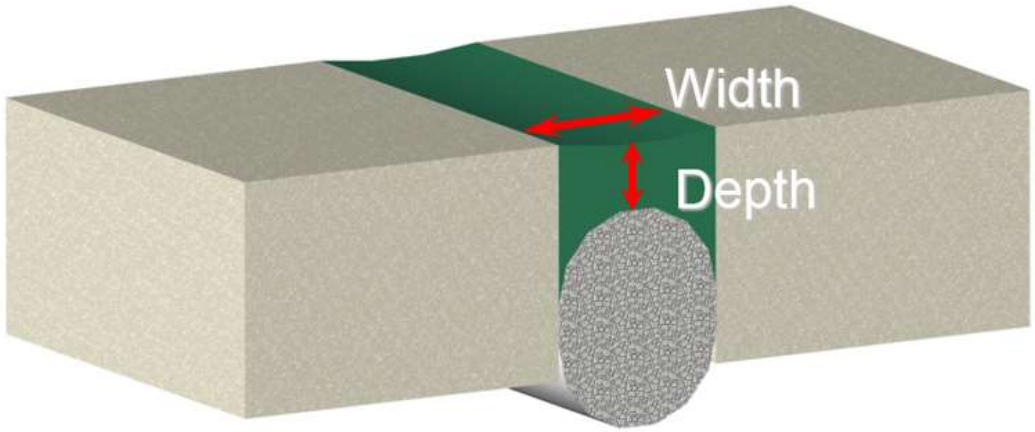
Three-Sided Adhesion - Prevention



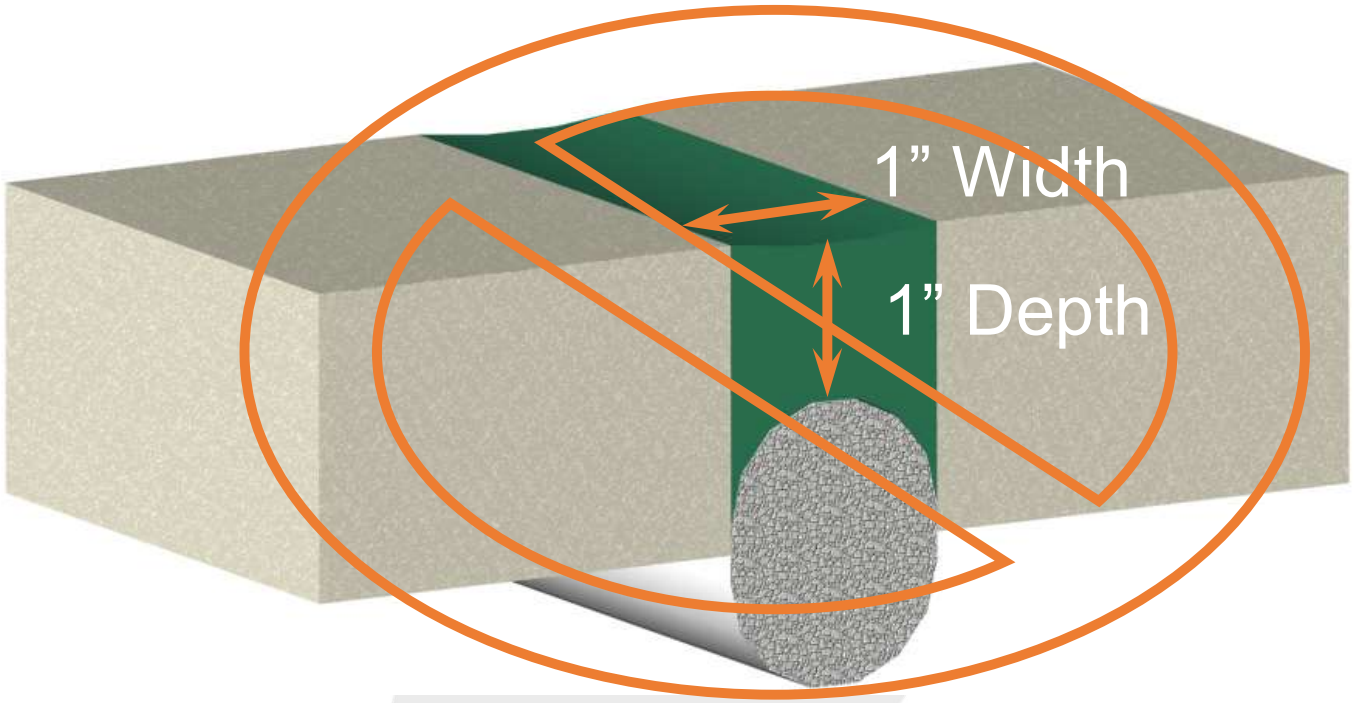
Sealant can now perform under compression

Typical Sealant Joint

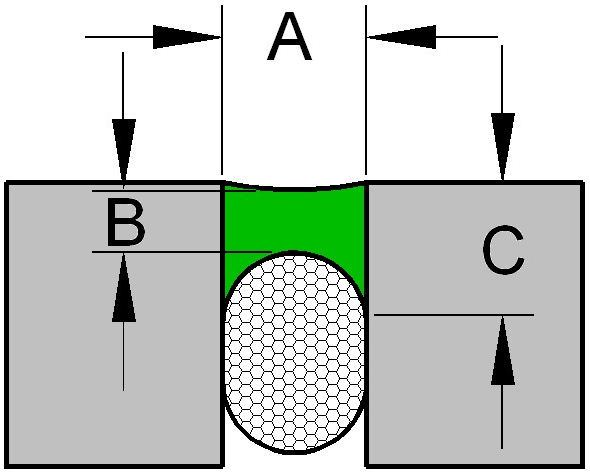
Sealant should have a width and depth ration of 2 to 1



Width to Depth Ratio



Sealant Width-to-Depth Recommendations

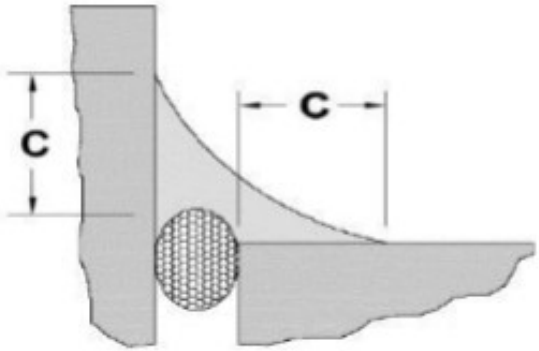


Joint width	Joint depth
¼ in. to ½ in. (6.35 mm to 12.7 mm)	Joint depth is equal to joint width
½ in. to 1 in. (12.7 mm to 25.4 mm)	Joint depth is half of joint width
1 in. and above (25.4 mm and above)	Joint depth is ½ in.

Sealant Dimensions

Perimeter Joints

- For fillet beads, or angel beads around windows and doors, the sealant should exhibit a minimum surface contact area (C) of ¼” (6 mm) onto each substrate,



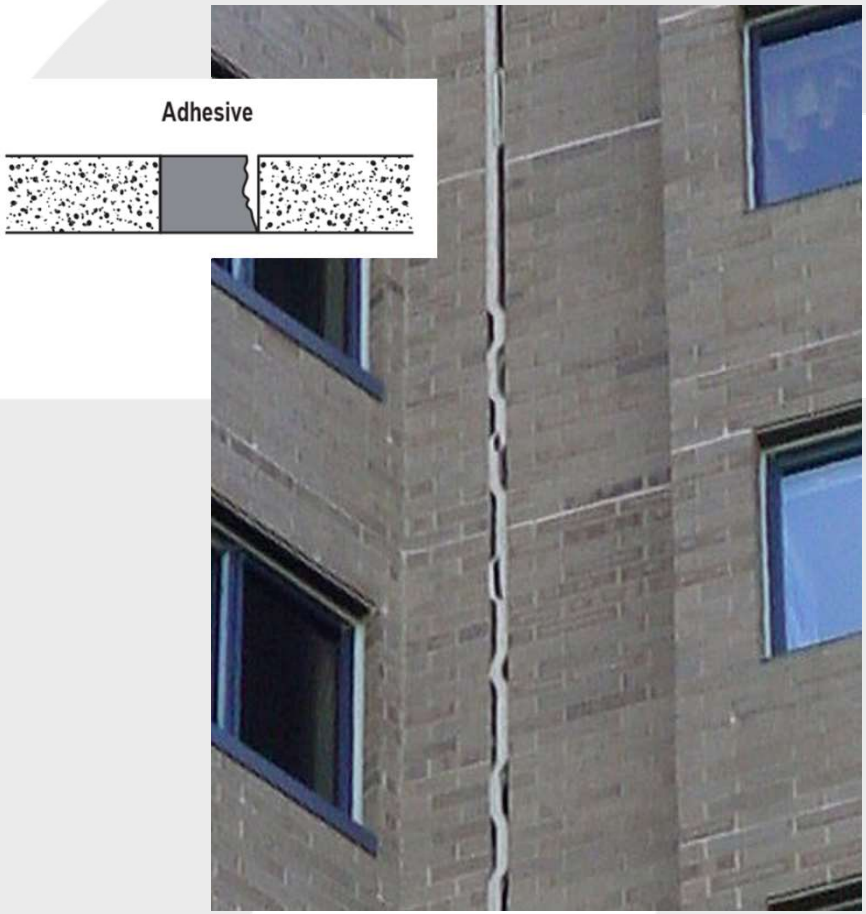
with provisions for release at the heel of the angle using backer rod or bond breaker tape

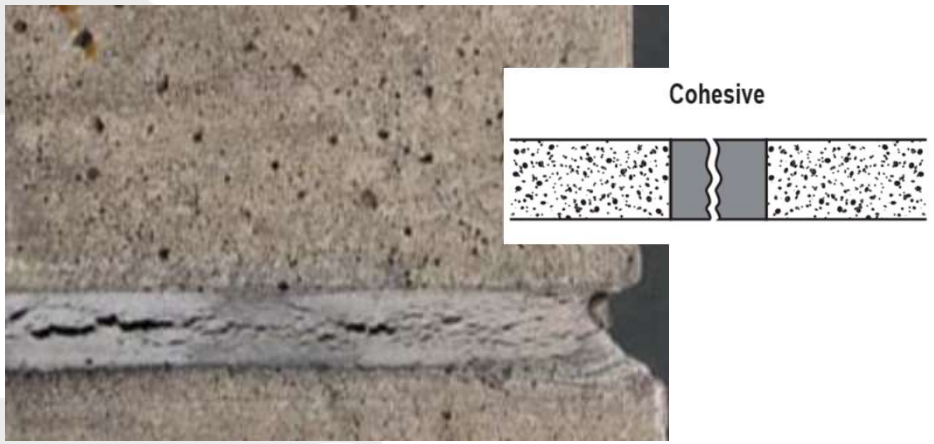
Sealant Installation

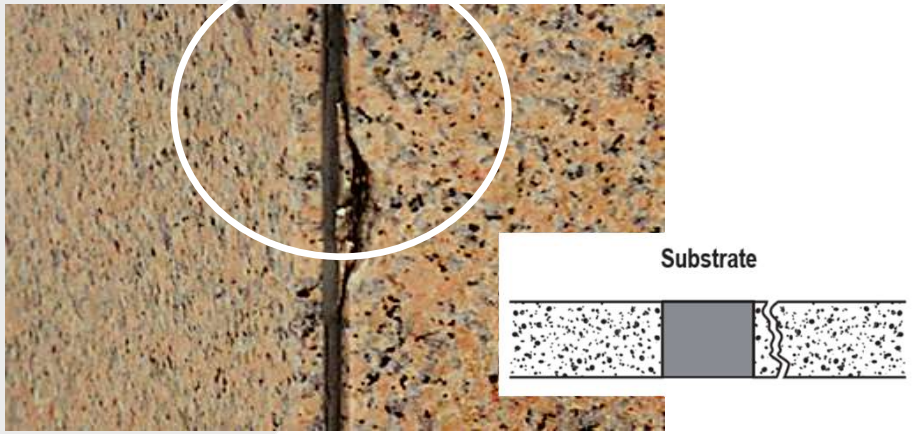
- Date and description of the weather conditions, including average air temperature
- Location(s) of the joints that were sealed that day
- Record of the crew(s) and where they worked that day
- Batch numbers of the sealant and primer (if required) used in each Notes of any unusual conditions encountered that day
- A record of checking the previous work completed for quality and performance

Sealant Installation

- The field adhesion test is simply a hand pull test of a cut area of joint sealant (Figure 1.1). The testing procedure can be found in Appendix X.I of ASTM C1193, Standard Guide for Use of Joint Sealants.
- Initial adhesion test – every 100 feet over first 1000 ft, every 1000 ft, one per floor , and one test per week per installation crew (Keep logged) thereafter.
- To confirm substrate was cleaned properly
- To confirm the correct amount of primer was used (if primer was used)
- To confirm appropriate tooling
- To confirm correct sealant used for the joint movement
- To check for improper joint configuration
- Verify no 3-sided adhesion condition exists
- Check for the presence of bond breaking material(s) at bond
- If poor results are obtained in a field adhesion test, work should be stopped to verify the root cause and magnitude of the problem.
    - Once the cause of the problem is identified, corrective measures can be implemented.
- Field adhesion tests should be repaired immediately to maintain the weatherproofing integrity.

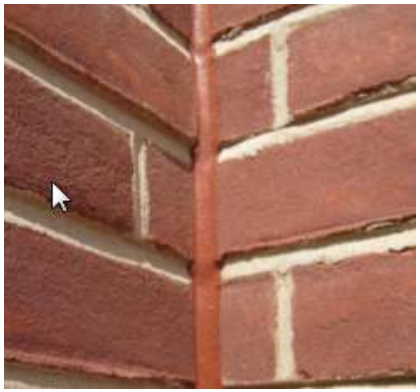

Adhesive


Cohesive


Substrate

Sealant Installation

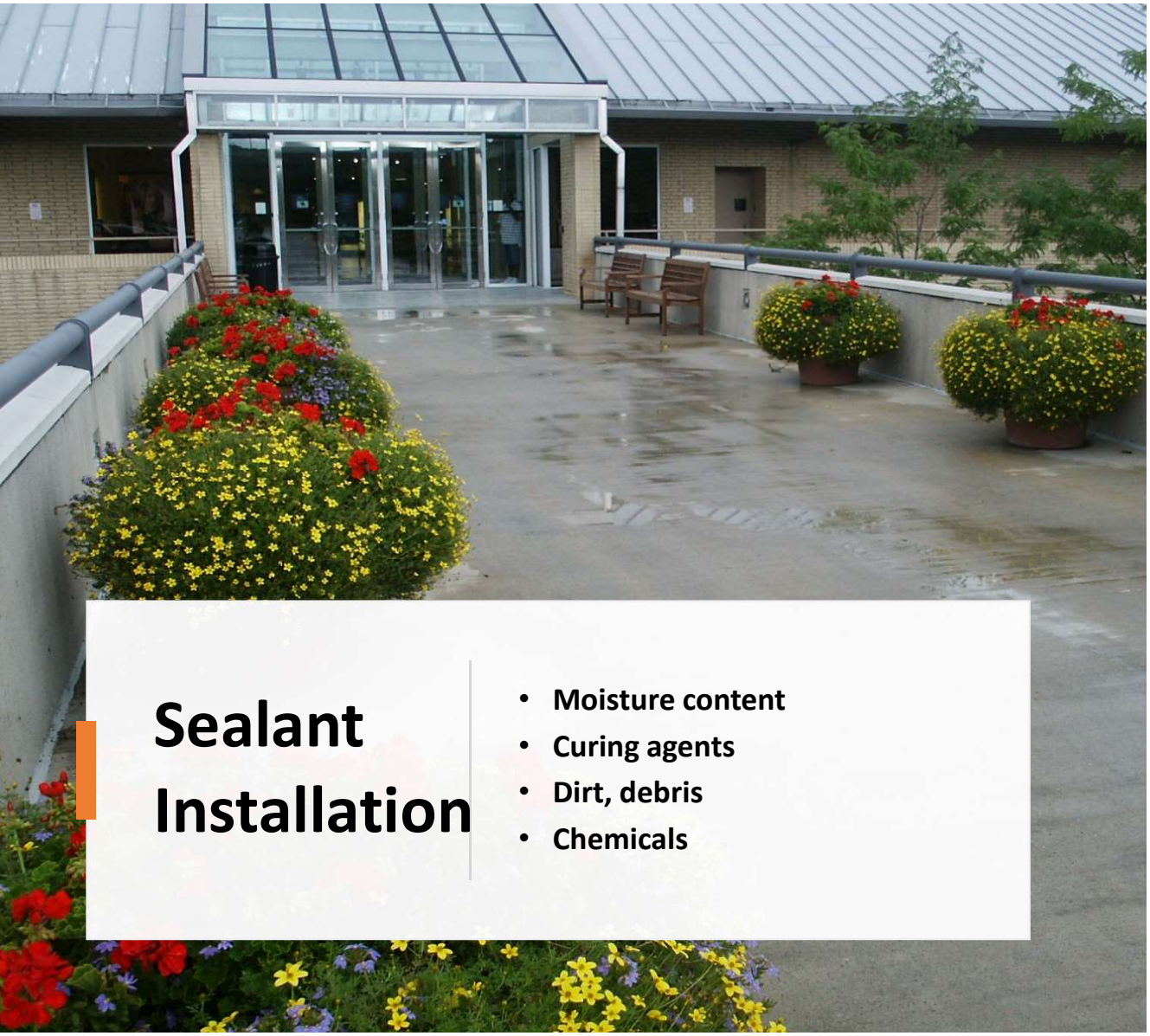
- What type of sealant?
- Will it adhere to the substrates?
- What is the joint size and shape?
- Is it continuous or do the anchors get in the way?
- Can it be installed as detailed?
- Is it part of the Manufacturers system or by another manufacturer? (accountability)
- Is it warranted?
- **Is it going to be a high stress joint?**



Sealant Selection

- Precast & Tilt-up
- Stone façade
- Brick
- EIFS
- Glazing
  - Curtain Wall
- Parking Deck & Sidewalks
- Plaza and Pool Decks
- Below Grade
- Coating Details
- Air Barrier Details

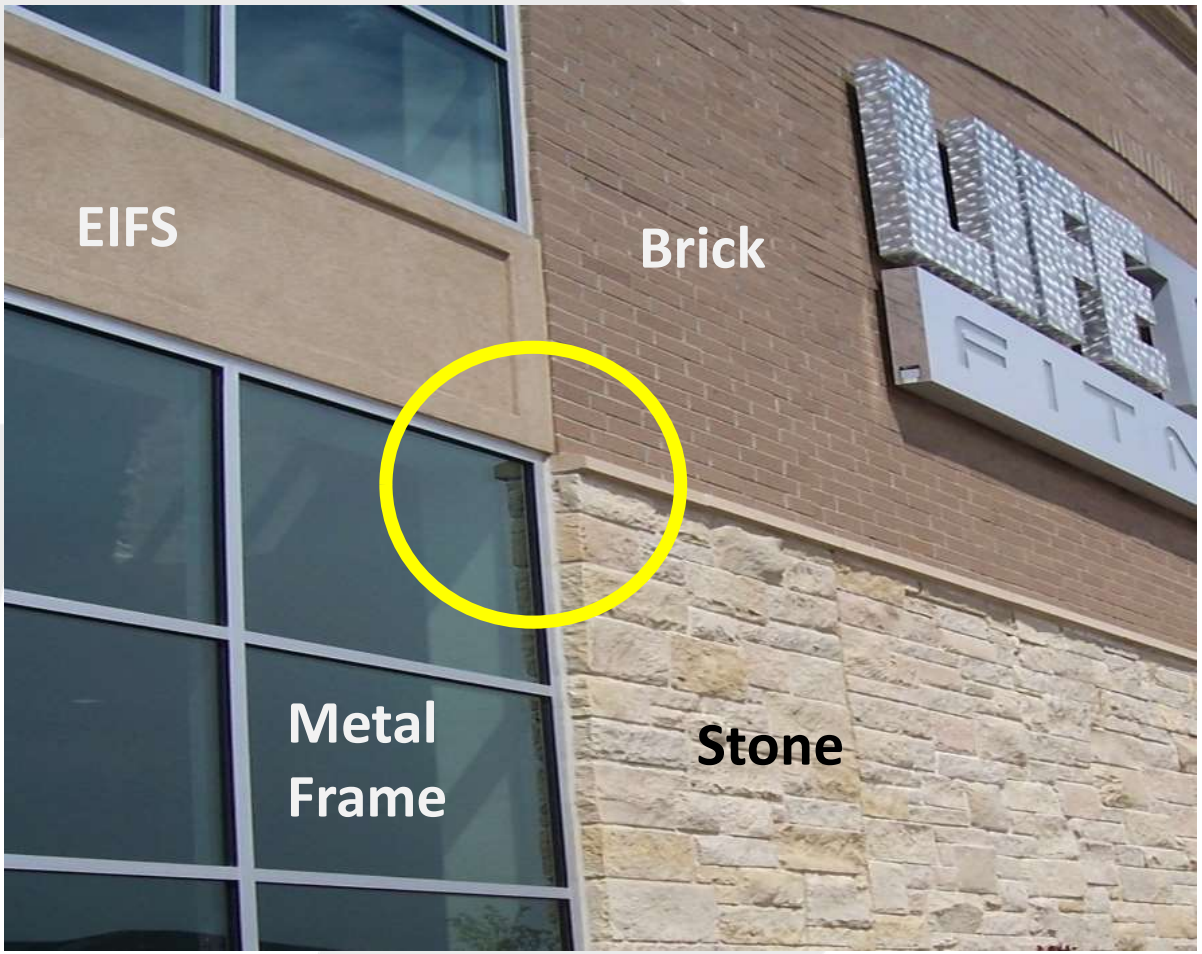

Jobsite Conditions

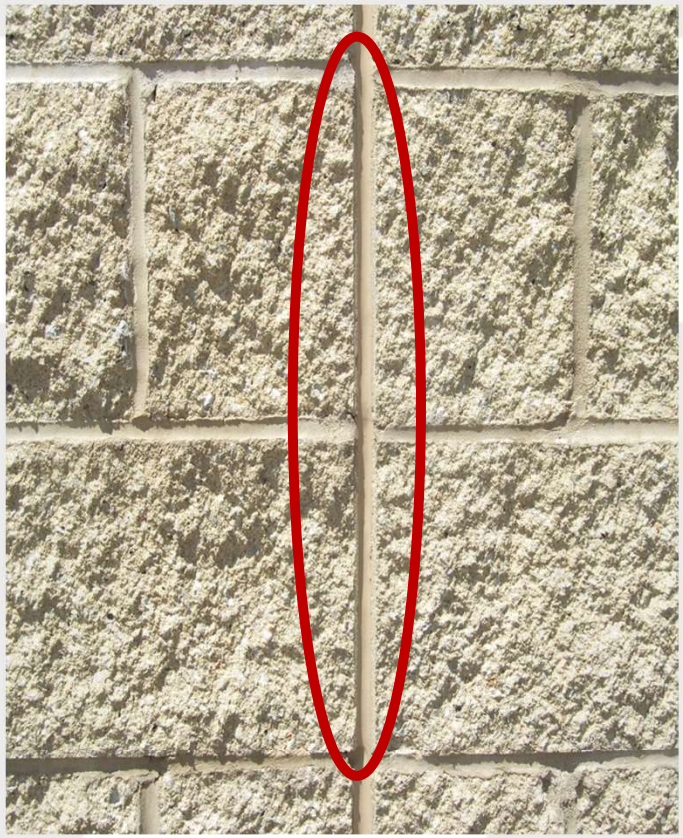


Sealant Installation

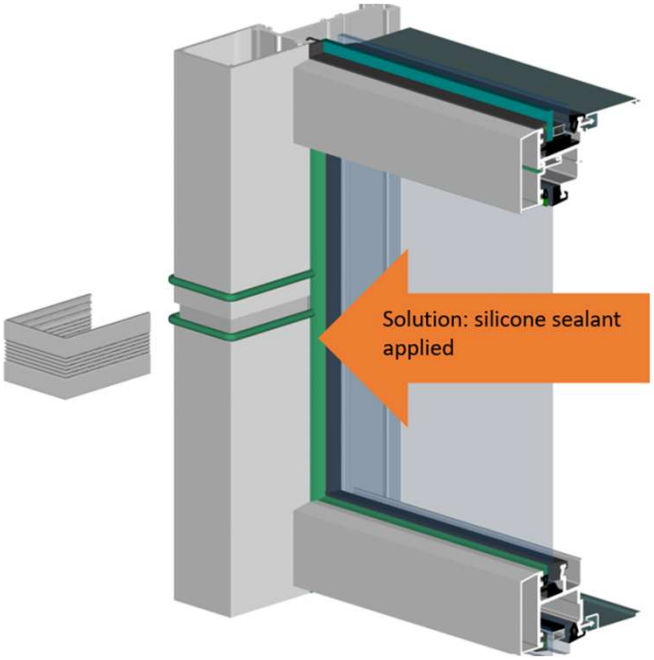
- Moisture content
- Curing agents
- Dirt, debris
- Chemicals

Sealant Installation

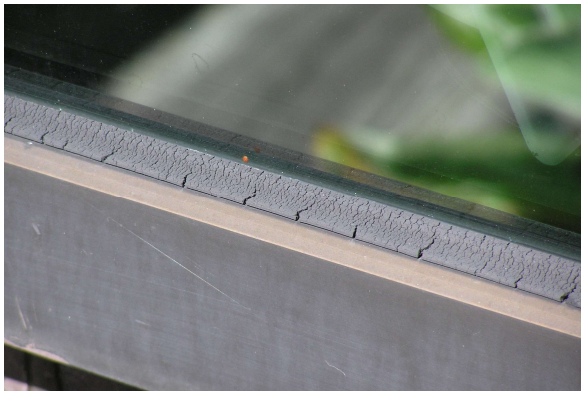





B12S20

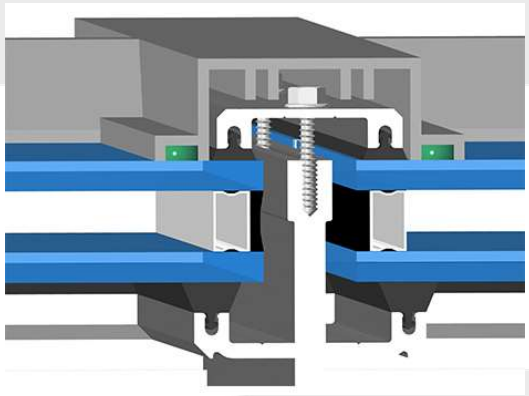

Solution: silicone sealant applied

Glazing Restoration



Why Glazing Restoration

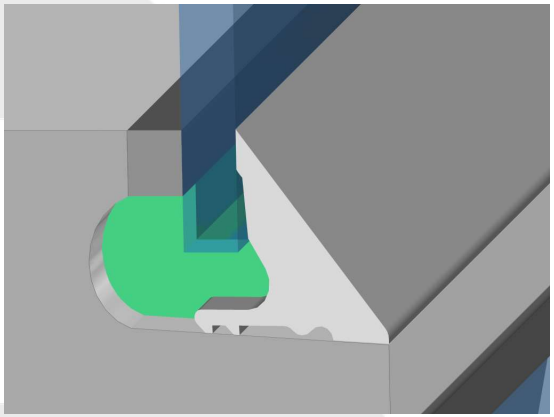
- **Improvement of energy efficiency**
  - Upgrading glass to double- or triple-glazed units
  - Wet sealing to reduce air leakage
- **Remedy of water intrusion**
- **Correction of improper installation**
- **Restoring performance lost due to aging of components**
- **Renewal of aesthetic**
- **Historic renovation**



After

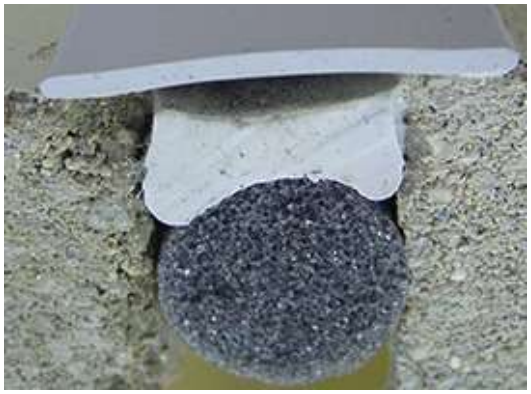
After

After



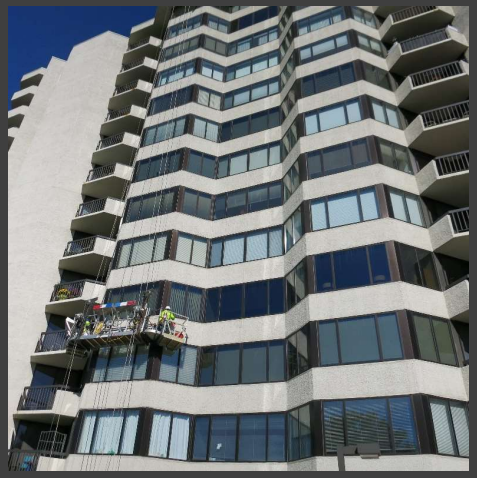
Preformed Options

- UV Stable, pre-compressed polyurethane foam.
- Interior or exterior joints
- Primary or secondary seal
- Vertical expansion joints
- Precast, masonry, or brick facades
- EIFS
- Primary seal in starter track for windows



Chemistry & Technology

- Pre-cured Silicone Extrusions
- Pre-cured Polyurethane Extrusions
- Pre-compressed Foam Tapes



Sealant Selection

What substrates are involved?

- Priming, adhesion, condition, staining concerns, moisture content, weather, temperature, firestopping

What level of expansion and contraction?

- Movement capabilities, hardness, modulus

Is cure time of sealant an issue?

- Single vs multi-component

Life expectancy

- Technology comparison

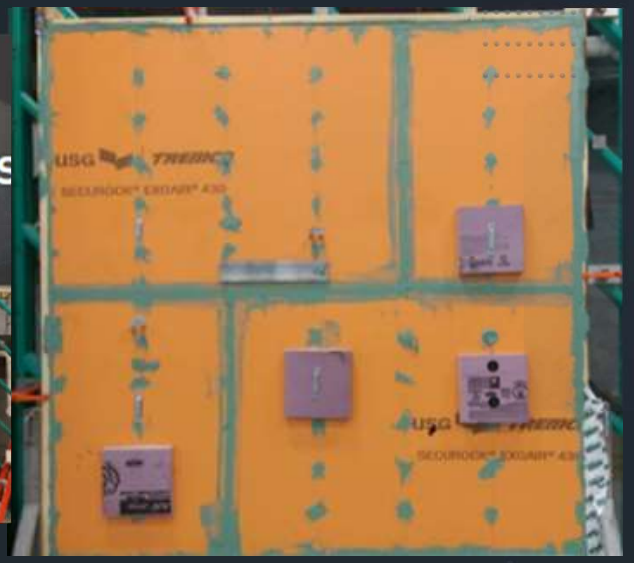
Color

- Color selection and matching

Cost

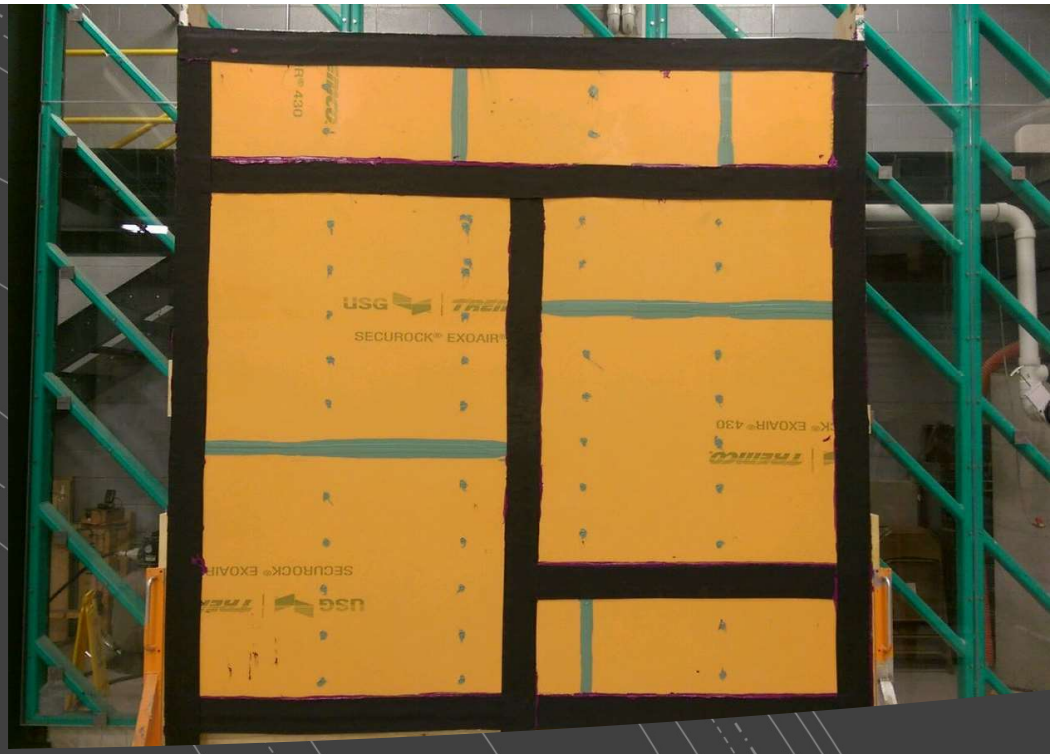
Bringing It All Together

TREMCO™
Construction Products Group



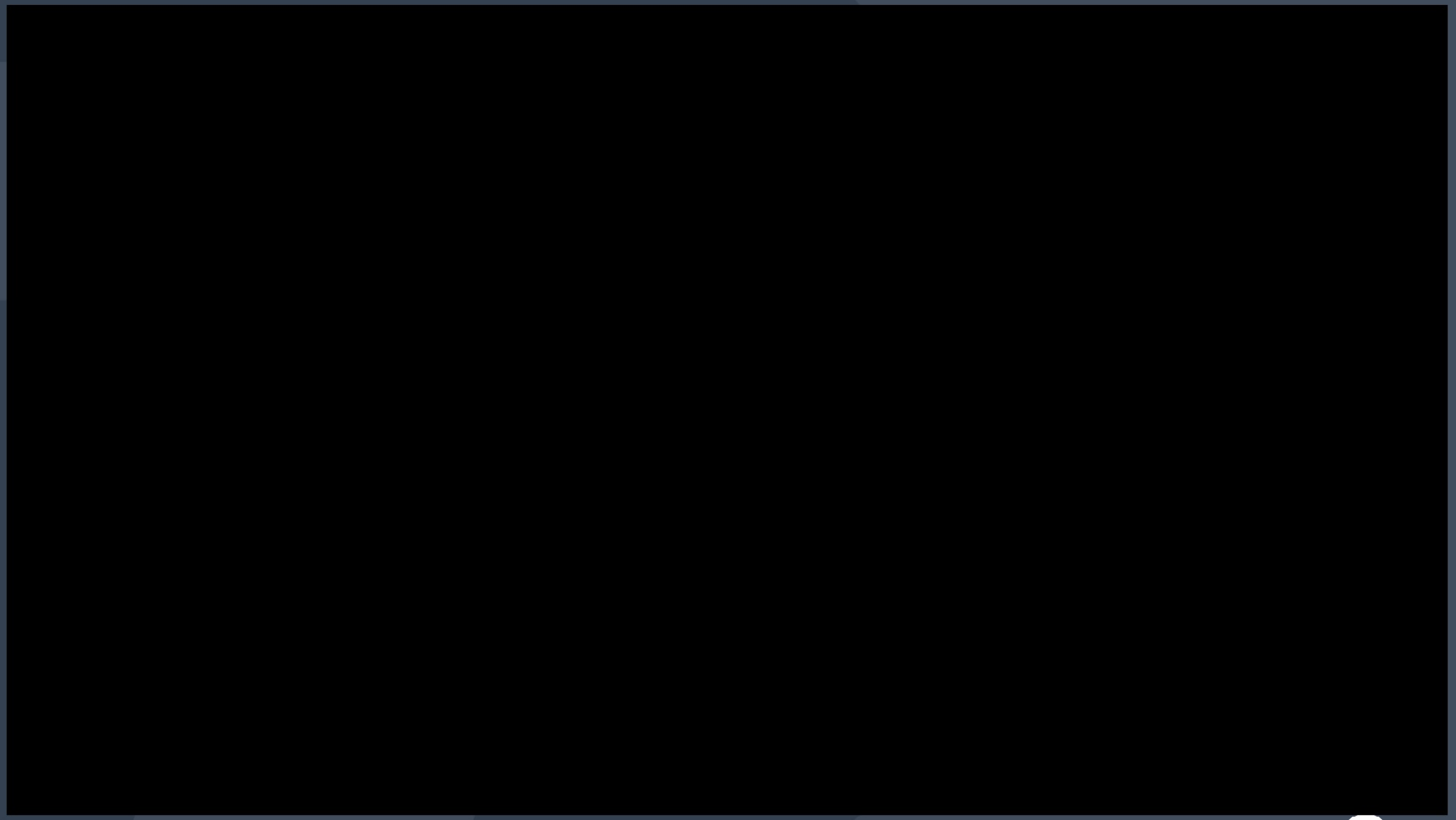
System Performance Testing

The Test Wall is made available as a tool to replicate the exact design intent and evaluate installation practices.



Mission Bay Block 33, San Francisco, CA

- UCSF Wayne and Gladys Valley Center for Vision
- Consultant did not want to use Tremco Expansion Joint Materials.
- Designed project specific mock-up to validate performance during earthquake.



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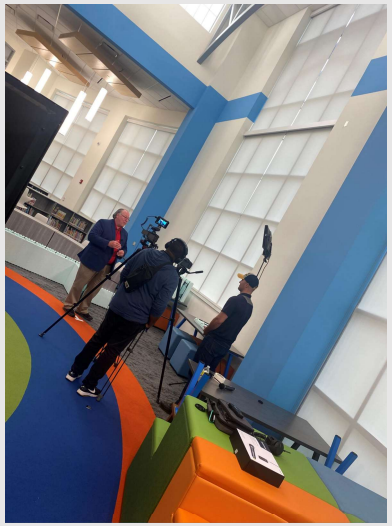
Blog & Broadcast Opportunity

Net-zero energy schools are old news in Kentucky

SHERMAN CARTER BARNHART ARCHITECTS

ALLIANCE CORPORATION
Builders & Managers



Want to join the conversation?

Interested in being a part of Build Meets World with your design challenge or solution, please feel free to reach out to me. We would be happy to host you on our broadcast.

Marcy Tyler
mtyler@tremcoinc.com