Construction

Construction Sealant Training

Presented by: Sika Corporation

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Joint Sealants: Topics of Discussion

- Terminology
- The purpose
- Typical applications
- Common problems
- Critical success factors
  - ➢Joint design
  - ➢Material Selection

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Introduction

- Sealants have been in use for many hundreds of years. The Tower of Babel was reportedly built with mortar and tar or pitch as a sealant. Naturally occurring bitumen and asphalt materials have been widely accepted as sealants for many centuries
- Prior to the 1900's most sealants evolved from vegetable, animal or mineral substances. The development of modern polymeric sealants coincided with the development of the polymer industry, sometime in the early 1930's.
  - 1950's - Polysulfide
  - 1960's – Polyurethane
  - 1970's – Silicone
  - 1990's – Silyl-Terminated Polyether (MS Polymer)

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Terminology – The Basics

What's the difference between a caulk and a sealant?

A caulk is any low or intermediate performance compound. Typically being lower quality and having limited service lives. For example: Acrylic Latex, Butyl, Butyl Rubber, Co-polymers, putty etc. Life cycle: usually 3 – 5 years.

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Terminology – The Basics

A sealant typically refers to a high performance compound having more expensive ingredients, little shrinkage, excellent weathering and UV resistance and providing long service life cycles from 10 – 20 years.

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Terminology – The Basics

- ASTM C 920
  - ➢The standard specification for elastomeric joint sealants. It is made up of several ASTM test methods including:
    - Movement capability (ASTM C 719)
    - Sealant hardness (ASTM C 661)
    - Tack free time (ASTM C 679)
    - Adhesion in Peel (ASTM C 794)

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Terminology – The Basics

- Sealant Hardness – ASTM C 661
  - ➢Is a measure of a sealants ability to resist the penetration by a Durometer probe.

Rated on a scale from 0 – 100. The lower the number the softer the sealant. The softer the sealant the more movement it can take. Conversely, the higher the number the harder the sealant is and the less movement it can take.

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Terminology – The Basics

- Movement Capability - ASTM C 719
  - Measures the cyclic movement (extension [+] and compression [-]) of a sealant. Classified with the following movement classes.
    - +/-12.5%
    - +/- 25%
    - +/- 35%
    - +/- 50%
    - +/-100/50%

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Terminology – The Basics

- Stress Relaxation – is the ability of the sealant to absorb extension without incurring additional stress on the bond line to the substrate.

  Sealants that recover completely and rapidly from deformation usually have less stress relaxation than those that recover slowly.

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Terminology – The Basics

- Low Modulus Sealant – Creates low stress at the sealant bond line. Usually has a higher movement capability.
- Medium Modulus Sealant – Typically a general purpose sealant that can be used for the majority of elastomeric sealant applications
- High Modulus Sealant – Not used for moving joints, typically used for glazing applications

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Joint Sealants

The Purpose

- Seal penetrations/joints between construction elements…a critical part of the building envelope
  - Some moving joints some non-moving
- Prevent ingress of water/moisture to building interior or through joints/gaps
  - Prevent water damage
  - Prevent reinforced concrete corrosion
  - Prevent structural steel damage
  - Help prevent mold development
- Prevent hard materials or snow/ice from entering openings or joints..structural damage

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Joint Sealants

The Purpose

- Accommodate Movement
- Function as Part of an Air Barrier System
- Function as Part of a Vapor Retarding System
- Acoustic Control

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Joint Sealants

Typical applications

- High-rise and low-rise commercial buildings:
  - Window perimeters
  - Roofing terminations
  - Expansion joints and butt-terminations
  - Glazing
- Plaza decks
- Major Chains (Tilt-up) Exteriors
  - HD, Target, Wal-Mart
- Institutional
  - Prisons and Schools
- Airport pavement runways and aprons

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Joint Sealants

Typical applications

- Bridge & Highway joints (DOT)
- Commercial parking lots and flat work
- Public Works
  - Sidewalks (concrete)
- Park Decks
  - Can be in combination with deck system
- Waste & Water
  - Submerged environments (NSF)
- Adhesive and bonding applications
  - Industrial, Residential and commercial

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Typical Sealed Building Products and Materials

- Concrete
- Masonry & Brick
- Wood, Plywood, and Cement-Based Siding
- EIFS (Exterior Insulation and Finish Systems)
- Stucco
- Stone, Manufactured Stone, Cultured Stone
- Vinyl and Aluminum Siding
- Painted Products
- Foam Plastic Panels
- Ceramic Tile
- Metal Panels (Coated and Uncoated)

- ***Systems include Doors, Windows, Skylights***

Joint Sealants

The applications

•Polyurethane sealants like Sikaflex 1a or Sika 15 lm exterior façade expansion and or control joints between brick-work..

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Joint Sealants

Precast Concrete Joints

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Joint Sealants

Precast Concrete Joints

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Joint Sealants

Window Glazing

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Joint Sealants

Expansion Joints

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Joint Sealants

EIFS

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Joint Sealants

EIFS

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Joint Sealants

Window Perimeters

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Window & Door Perimeters

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High Rise Buildings

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Vertical joints in concrete

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Joint Sealants

Plaza Decks and Sidewalks

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Joint Sealants

Common problems

- Sealants are probably the least thought about and add the lowest percentage to a project cost - however can become the biggest problem if the building starts to leak
- There is both science and art to completion of proper joints from design to sealant placement
- Need to have:
  - Proper joint design
  - Proper product
  - Proper application

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Joint Sealants

Common problems

Adhesion Failure – when a sealant de-bonds from the surface it was applied to.

- Poor Surface preparation
- Not correct sealant for application
- Improper priming

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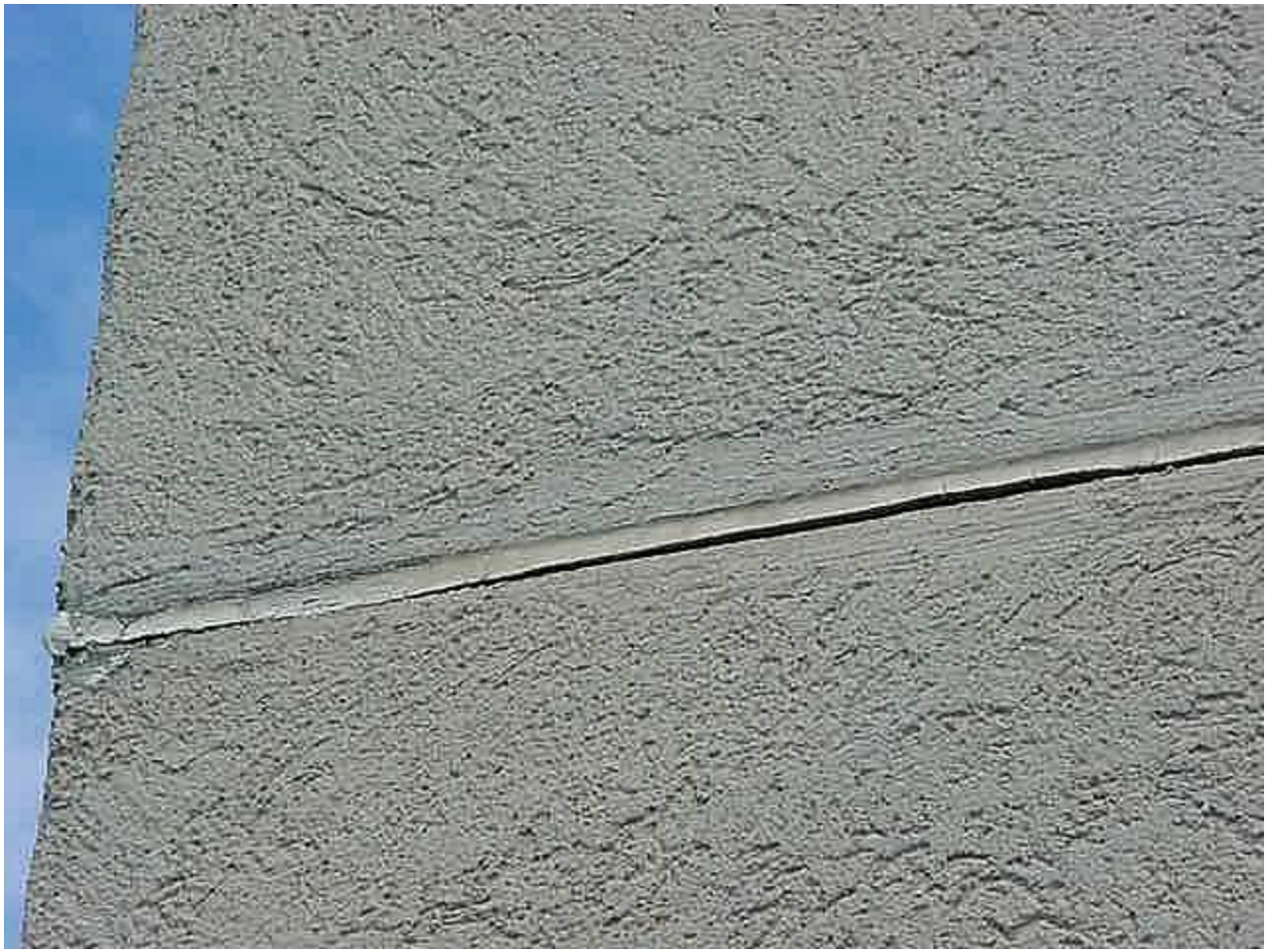
Typical Loss of Adhesion



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Typical Adhesion Loss

Note: severe weathering and UV degradation resulting in chalking and surface crazing of the sealant.

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Common Problems: Adhesion Failure

- Causes
  - Poor surface preparation
  - Contamination
  - Improper installation
  - Improper priming
- Remedies
  - Grinding
  - Proper cleaning
  - Proper priming
  - Proper tooling

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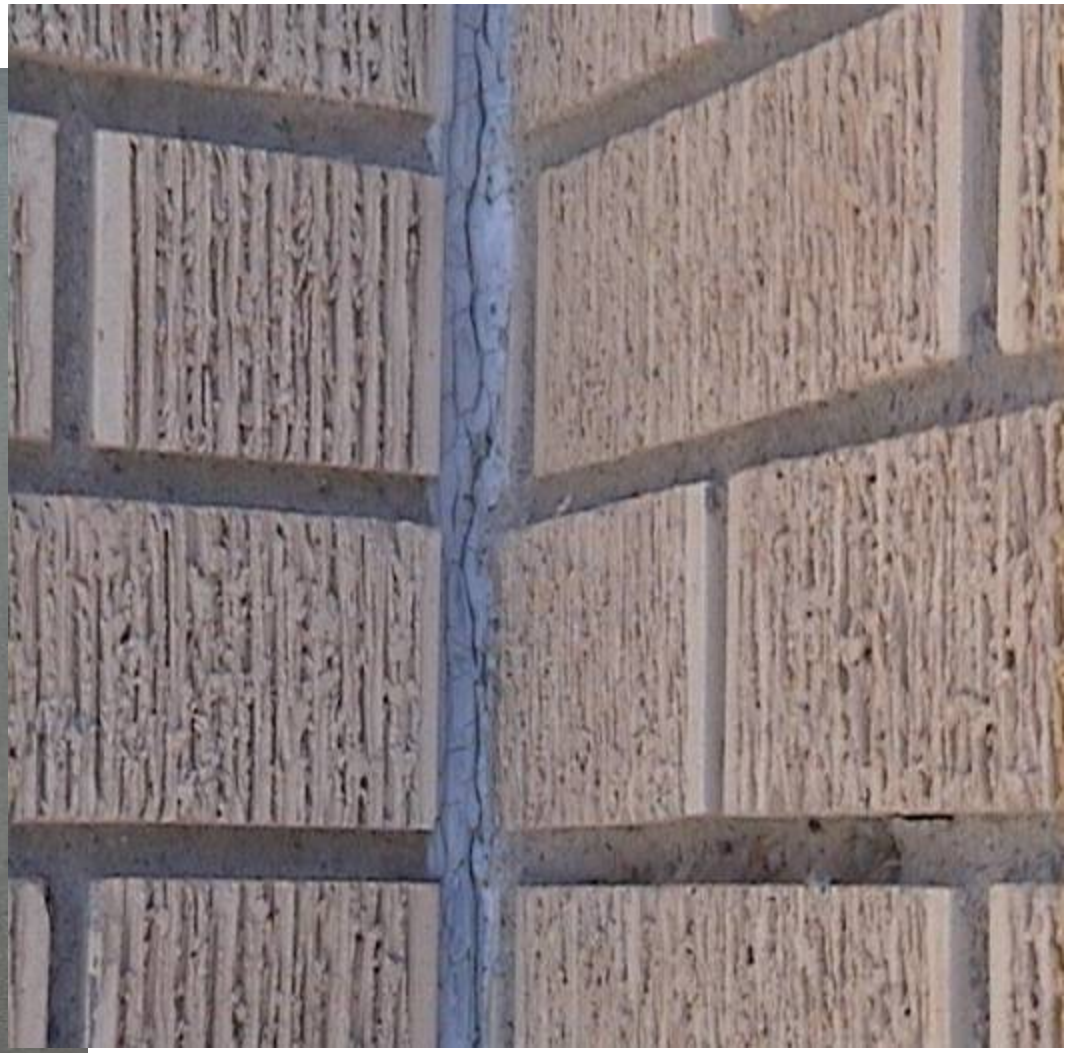
Joint Sealants

Common problems

- Cohesion Failure – the tearing or splitting of the sealant down the middle. Usually it remains adhered to the sides of the joint. Reasons for cohesive failure are:
  - ❖ Excessive movement beyond the sealants ability
  - ❖ Three sided adhesion
  - ❖ Inadequate thickness of sealant to function in the joint

Cohesion Failure



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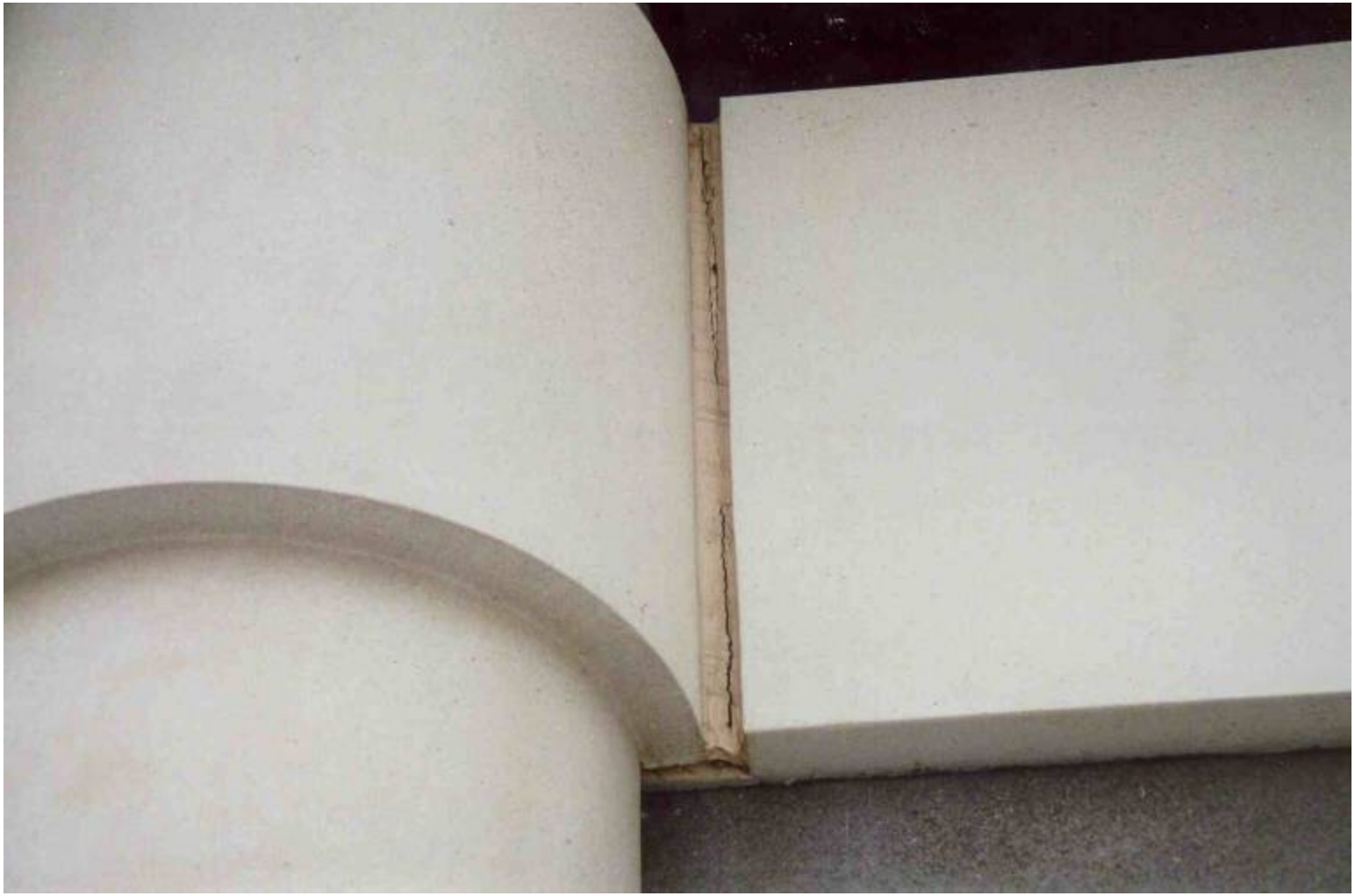
Cohesive Failure



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Common Problems: Cohesive Failure

- Causes
  - Poor joint design
  - Improper W/D ratio
  - Wrong sealant
- Remedies
  - Proper joint design
  - Choose the right sealant
  - Install correctly

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Substrate Failure

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Common Problems: Substrate Failure

- Causes
  - Weak Substrate
  - High Modulus Sealant on EIFS
  - Sealing to EIFS Finish Coat
- Remedies
  - Grinding or Wire Brushing
  - Lower Modulus Sealant
  - Sealing to EIFS Basecoat

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Joint Sealants

Common problems- Substrate Staining

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Staining of Sensitive Substrates

- Staining is caused by non-reacted fluids in the sealant formulation
- Any sealant can stain if poorly formulated or used on a non-recommended substrate
- Require stain testing per ASTM C-1248 and a non-staining warranty from the sealant manufacturer

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Granite Staining

Marble Staining

Rundown On Glass and Metal

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Joint Sealants

Common problems – improper tooling

Tooling should be done to give the sealant surface a smooth uniform appearance

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Joint Sealants

Common problems

Sealant coated with non elastomeric coating. Sealant can move, but not the coating

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Critical Success Factors

- Joint design
- Material Selection

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Critical Success Factors

Joint Design

Standard Recommended Practice:

- Joint depth no smaller than ¼” and no greater than ½”
- Use 2:1 width to depth ratio up to 1” in width. Consider an “hourglass” shape.
- Joint designed within sealants movement capability
- Movement-related: Allow for both conditions
  - A joint sealed at the lowest temperature will ALWAYS experience compression
  - A joint sealed at the highest temperature will ALWAYS experience extension

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Critical Success Factors

Joint Design

- Joint depth should be sufficient to accept backing materials and proper depth of sealant
- The number and spacing of joints is absolutely critical to performance
- Joints should be accessible for sealant placement
- There should be sufficient bonding surface for sealant
  - Window perimeters
  - Exposed aggregate facades

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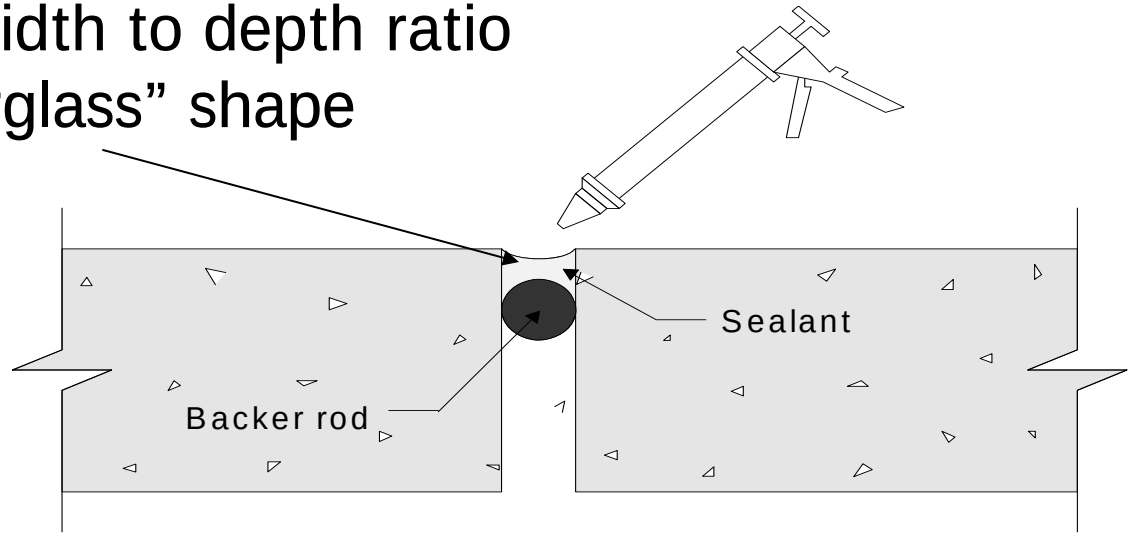
Critical Success Factors

Joint Design

2:1 width to depth ratio
"Hourglass" shape



1. Install appropriate backer material to prevent three-sided adhesion and to control sealant depth.
2. Sealant should be gunned into joint at mid-point of designed expansion and contraction.
3. Tool as required to properly fill joints.

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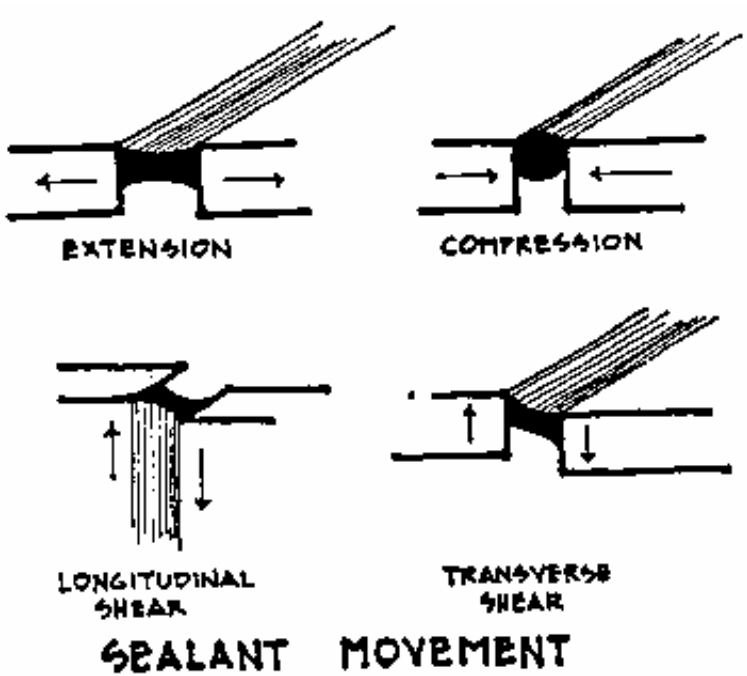
Movement Capability..



- Movement Capability- The +/- percent value that indicates the amount of movement the sealant can take in “extension (+)” and/or “compression (-)” from it’s original cured joint width.

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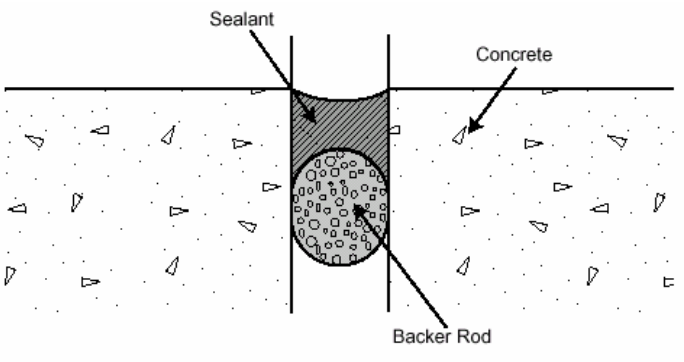
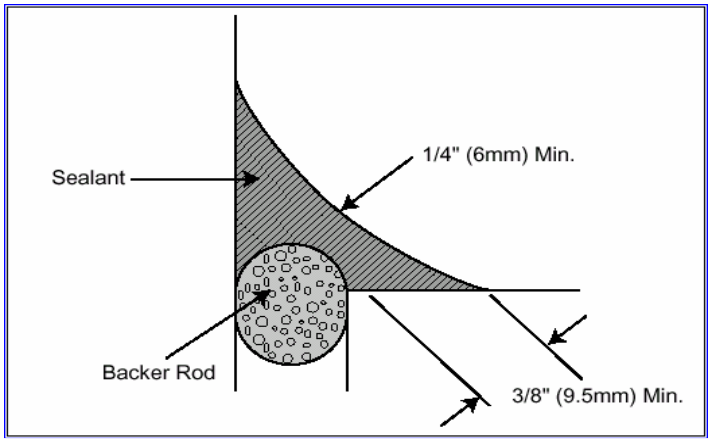
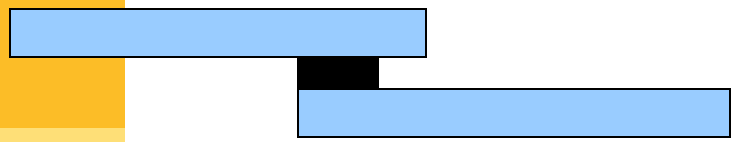
Examples of Movement Joints



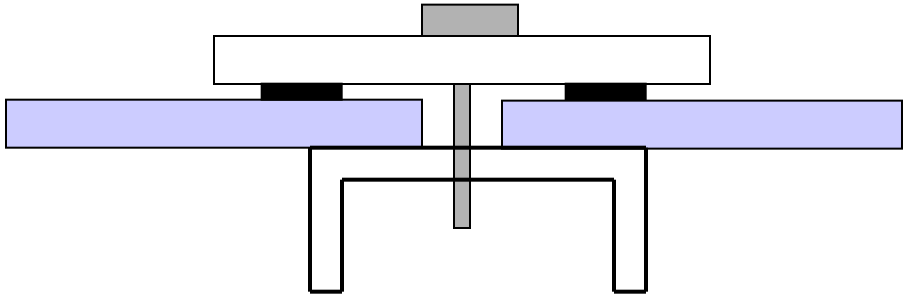
Butt Joint



Fillet Joint



Lap Joint



Interlocking Joint

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Critical Success Factors

Material Selection

- Will the selected material handle the anticipated joint movement requirements
- Adhesion to substrate is probably the most critical element in the selection process
- Does the joint size allow for sufficient placement of selected materials
- Will the product perform under the stated conditions of use
- Is there history of application success
- Evaluate the suppliers resources
- Third party testing should confirm product performance

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Sealant Types

- Most Common Field Molded:
  - Latex
  - Acrylic
  - Butyls
  - Polysulfides
  - STP/MS Hybrids
  - Polyurethanes
  - Silicones

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Sealant Types

- Factory Molded
  - ➢Gaskets and seals
  - ➢Strip-seals
  - ➢Compression systems

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Sealant Types

Field molded

- Latex:
  - Some refer to as caulk not sealant
  - Interior applications
  - +/- 10% movement capability or less
  - Paintable with latex paints
  - Interior applications only
    - Dry wall to trim work
  - Not for “true” joints (those expected to exhibit significant cyclic movement)

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Sealant Types

Field molded

- Acrylics:
  - Some refer to as caulk not sealant
  - Generally +/- 12.5% movement
  - More flexible than latex caulks but still not high performance by industry standards
  - Can be paintable

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Sealant Types

Field molded

- Butyls:
  - Bond excellent to most substrates
  - Poor movement, generally +/-10% or less
  - Poor weathering
  - Good as adhesive in industrial and packaging applications
  - Sometime used in curtain wall where adhesion to rubber compounds is needed
  - Most are stringy and difficult to apply neatly

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Sealant Types

Field molded

- Polysulfide:
  - The first ‘high performance’ sealant chemistry, do not perform as well as newer polyurethanes and silicones in moving joints
  - Poor recovery
  - Can be formulated for excellent chemical resistance
  - Good in submerged applications
  - Require primer on almost all substrates

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Sealant Types

Field molded

- STP/MS Hybrids
  - ➢Silane Terminated Polyether or Polyurethane
  - ➢No glazing (avoid direct contact to glass)
  - ➢Excellent bonding, generally without a primer to non porous substrates
  - ➢Good UV resistance
  - ➢Excellent weathering

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Sealant Types

Field molded

- Polyurethanes:
  - Most common sealant for a wide variety of substrates
  - No glazing (avoid direct contact to glass)
  - Excellent bonding, generally without a primer especially to cement based substrates like concrete and masonry
  - More forgiving in less than perfect application conditions
  - Good UV resistance
  - Excellent weathering

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Sealant Types

Field molded

- Silicones:
  - Structural bonding and stop-less glazing of glass to frames
  - Excellent UV and stability
  - Good adhesion to many substrates especially glass, often a primer is recommended on many substrates, particularly porous
  - Adhesion is adversely affected by less than perfect application conditions
  - High, medium and low modulus materials available

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Uses by type

Use	Latex	Acrylic	Butyl	Polysulfide	Silicone	PU
submerged	1	1	3	4	1	4
interior	4	4	3	3	4	4
exterior	1	2	1	3	4	4
struct. Glazing	1	1	1	1	4	1
window perimeter	1	2	1	3	4	4
expansion joints	1	1	1	2	4	4
traffic joints	1	1	1	3	2	4
wide joints	1	1	1	1	3	3
paintable	4	3	2	1	1	4
chem. Resist	1	1	1	4	1	3
EIFS	1	1	1	1	4	4
Tilt-up	1	1	1	2	2	4
pre-cast	1	1	1	2	4	4
cast-in-place	1	1	1	2	3	4
brickwork	1	1	1	2	2	4
curtain wall	1	1	2	2	4	2
UV resistance	1	3	2	3	4	3
1=NR, 2=poor, 3=good, 4=excellent						

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Critical Success Factors

Material Selection

Key Material Features	
POLYURETHANES	SILICONES
• Superior primerless adhesion to porous substrates and very forgiving to less than pristine application conditions.	• Superior adhesion to glass, especially in applications subject to reflected UV at bond line.
• Non-staining: no fluid migration from sealant to porous substrates.	• Material does not chalk or discolor over long term exposure to UV.
• Resistant to dirt pick-up during and post installation.	• Non-yellowing
• Use in submerged applications	
• Paintable with most water based elastomeric coatings	

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