



OUR EXPERIENCE IS YOUR SUCCESS - SERVING WASHINGTON & OREGON STATE

A MWOBE / SDB / UNION COMPANY

BUILDING ENVELOPE SEALANTS - REMEDIAL SEALANTS MASONRY

CONCRETE RESTORATION - AIR BARRIERS - DECK COATINGS

WATERPROOFING - FIRE STOPPING AND *HWY EXPANSION JOINTS.*

30 YEARS OF INSTALLATIONS WITHOUT A
SINGLE CALL-BACK OR CLAIM.

Program Agenda

Program Objectives

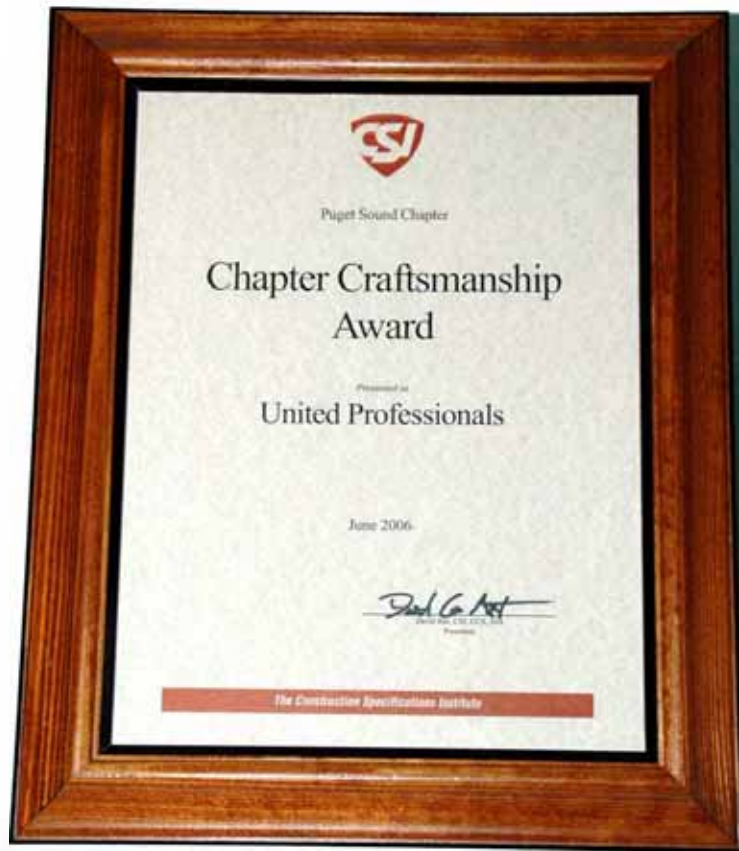
- ❑ Introduce UNIPRO skills and projects
- ❑ Identify procedures used to evaluate Sealant Performance in the joint.
- ❑ Degradation factors and their effect on sealants and sealed joints
- ❑ Interpret Sealant Failure and identify the cause or causes of a failed joint.
- ❑ Durability Assessment Methodologies
- ❑ *Answer any and all your questions*



Discussion/Questions:

Training – Education – Apprenticeship Testing - Certification

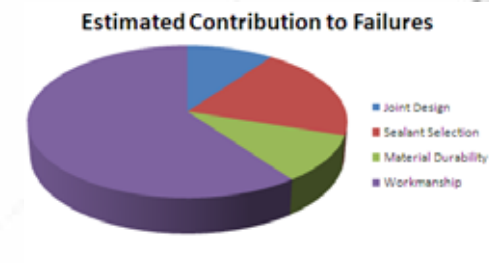
Joint Sealants in Construction



- **Training**
Application - Installation
- **Education**
Construction Defect – Systemic Defects
- **Apprenticeship**
Practiced Skills & Craftsmanship
- **Testing**
Quality – Integrity- Trustworthiness
- **Certification**
Confidence & Ability

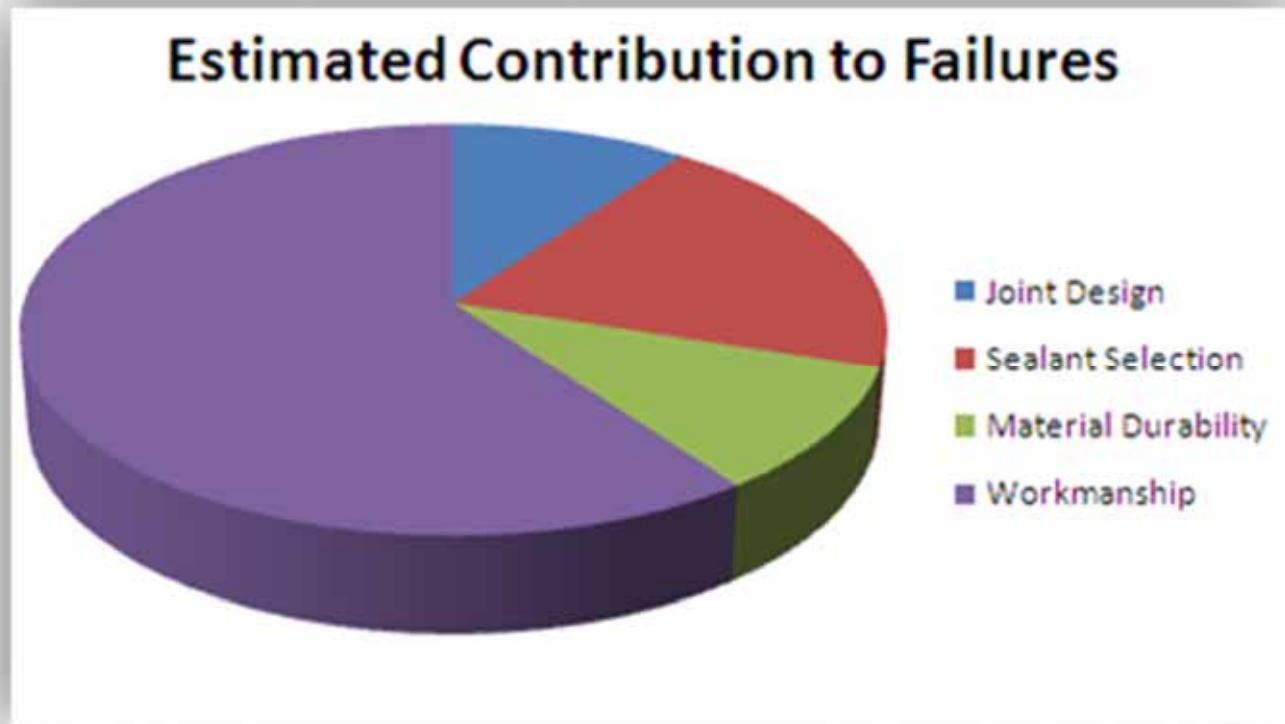
Parameters that Affect:

- **In-Use Service Life of Adhesives**
- **Sealants in Building/Construction**
- Poor Joint Design (Architect – Designer - Engineer)
- Improper Sealant Selection (Specifier - Applicator)
- Poor Material Durability (Manufacturer - Specifier: Unproven Technology, Novel Use, Excessively Harsh Environment)
- Poor Workmanship (Applicator)



This slide shows the importance of investigating the credentials of your next sealant contractor.

Applicator Errors



Showing the importance of a good resume.

Industry Assessment

“A well-sealed building is a combination of good design - the right product - and proper workmanship.”

“Proper attention to details in all areas are essential. Attention to proper workmanship will increase, with eventual certification of sealant applicators, or credentials to indicate that the workers have mastered the basic skills.”

Jerome M. Klosowski, 1989, Scientist/Inventor—Dow Corning Corp.

Industry Assessment (Why Important?)

- **Nearly 60% of all gun-grade joint sealants** (globally) are used in construction.
- In 1996, this amount was of the order of 420,000 Metric Tons
- **At a cost of about \$30 billion**
- Equivalent of sealing 5 million miles of joinery
- **Survey in the United Kingdom in 1990 revealed:**
 - **That 55% of all building joint seals had failed within 10 years of service.**
 - **Only 5% had lasted for more than 20 years.**
 - **That's a 95% failure rate in less than 20 years.**

Cause:

- **Incorrect sealant specification**
- **Inappropriate joint design**
- **Lack of appreciation of joint movements.**
- **Poor workmanship.**

References

1. Woolman, R. And Hutchinson, A., Resealing of Buildings: A Guide to Good Practice, Butterworth-Heinemann, Oxford, UK, 1994.
2. Grunau, E., "Service Life of Sealants in Building Const." Research Report, Federal Ministry for Regional Planning, Bonn, Germany, 1976.
3. Chiba, R., Wakimoto, H., Kadono, R., Koji, H., Karimori, M., Hirano, E., Amaya, T., Sasatani, D., & Hosokawa, . Improvement System of Waterproofing by Sealants in Japan, Japan Sealant Industry Assoc., Tokyo, Japan, 1992, pp. 175-199.



\$20,000,000,000

2009 Estimate of litigation associated
with leaky buildings water-intrusion, mold, and mildew.

ASTM/RILEM - Symposia Series

- Initiated by RILEM TC139-DBS, continued by RILEM TC190-SBJ and ASTM International with expanded scope
- 1994: London, UK “DBS” (RILEM)
- 1997: London, UK “DBS” (RILEM)
- 2000: Ft. Lauderdale, FL “DBCS” (RILEM)
- 2003: Ft. Lauderdale, FL “DBCSEA-1” (ASTM)
- 2005: Reno, NV “DBCSEA-2” (ASTM)
- 2008: Denver, CO “DBCSEA-3” (ASTM/RILEM)
- **2011: Anaheim, CA “DBCSEA-4” (ASTM/RILEM)**

Service Life Prediction of Sealants *via Outdoor Exposure Testing*

(Temp Driven Strain Cycling) – 5 Months

Conclusions:

- ❑ Stiffness increases due to a progressive compression set inducement.
 - ❑ Takes place in buildings during prolonged high temperature.
- ❑ Rapid Transition in Temperatures can result in failure due to stress.
- ❑ **Compression Set may be a key factor in a sealant's durability.**



Chicken Problem Revisited

Outdoor Aging (26 months)



Total dose is important, not time or rate of exposure

Outdoor exposure



Laboratory (2 weeks)



Indoor exposure at 55C - 80%RH



Same mechanism is operating for both environments.

Model Studies (Predictive)

Custom Built Sealant

Testing Chambers (NIST)

National Inst. of Standards & Technology

Laboratory tests: Expose in chamber for 1 month:

3 Temp: 10 C to 50 C

4 RH: 0 % to 75 %

2 UV: Radiation

1 Motion: Cyclic Fatigue

Modulus, Stiffness, & Stress Relaxation Behavior

Systematically Assess Sealant Degradation – Decreasing Modulus

Integrating Sphere
(Death Star)



What Is the Role of a Sealant?

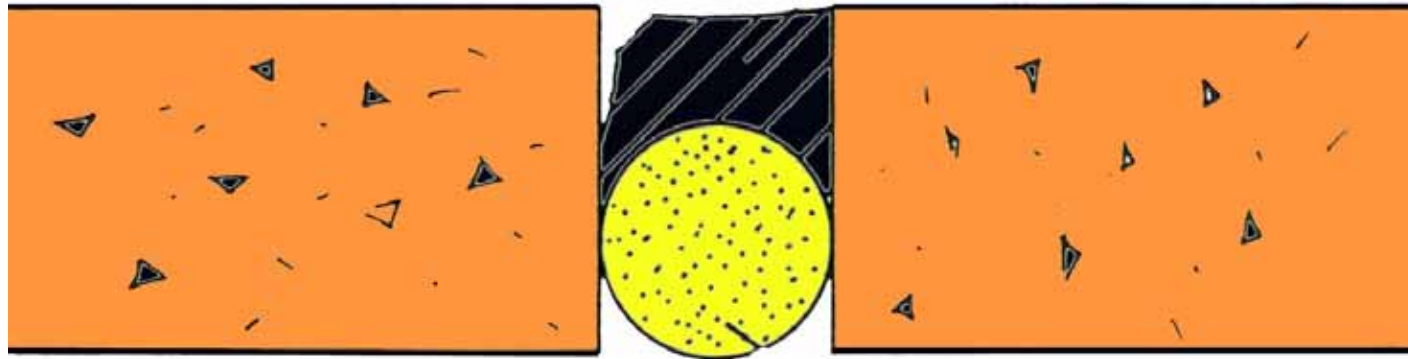
- Stop water and air intrusion.
- Coefficient of Thermal Expansion (in/in/° F)
 - Aluminum = 12.9×10^{-6}
 - Glass = 5.1×10^{-6}
 - Concrete = 6.5×10^{-6}
- Sealant joints accommodate differential thermal movement and other structural movements.



Adhesion Failure

Adhesive Failure

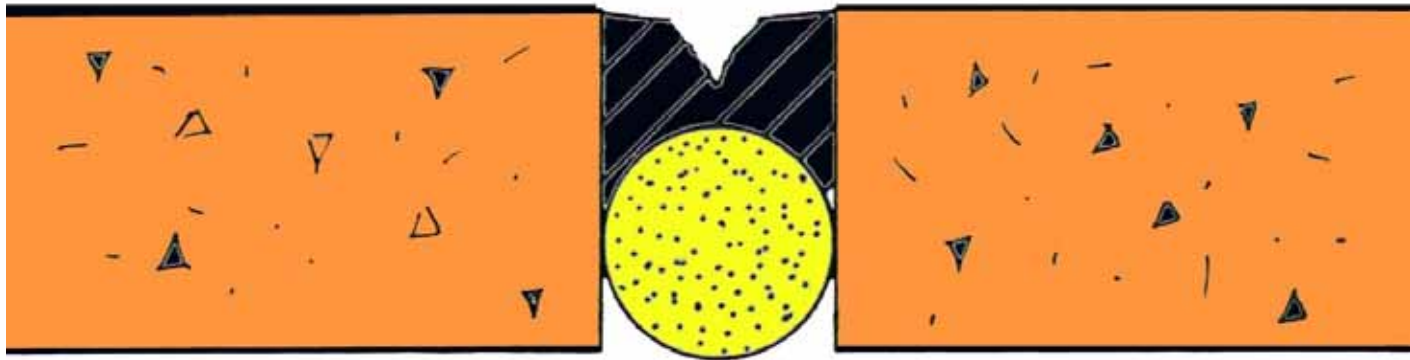
1. Did the joint exceed the expected movement?
2. Was the right material installed?
3. Was the joint prepared properly (cleaned - primed)?
4. Was the sealant installed properly (depth & profile)?
5. What is the expected lifetime of the sealant?
6. Has the adherend (substrate) maintain its strength or deteriorated due to fatigue?



Cohesive Failure

Cohesive Failure

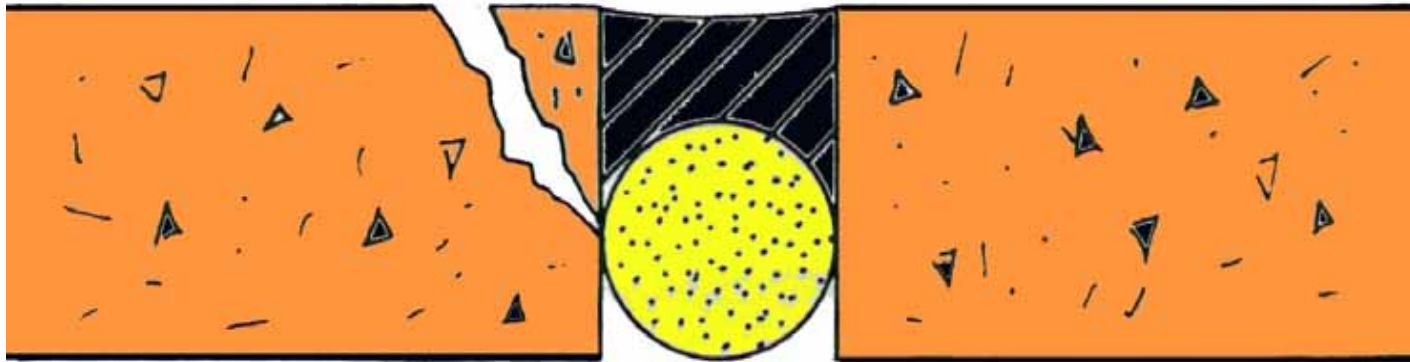
1. Was the sealant of proper depth?
2. Has the joint moved more than the sealant's ability?
3. If a multi-component, was material mix correctly?



Substrate Failure

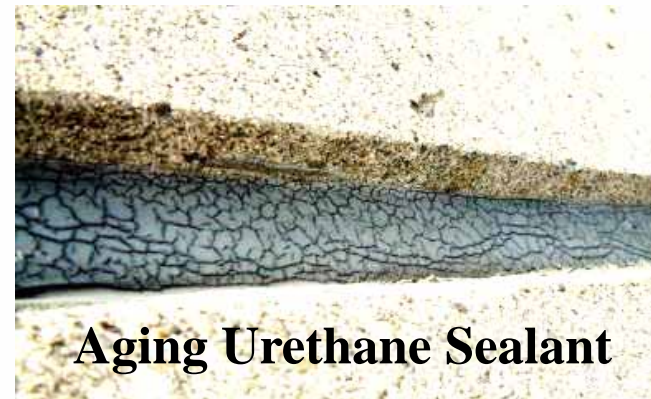
Substrate Failure

1. Was there vandalism?
2. Was the spec'd sealant used?
3. Was there outside truma to the substrate?
4. Was the sealant installed properly?
5. Were the substrates to adhere to built properly i.e., mixed properly, attached properly, etc.

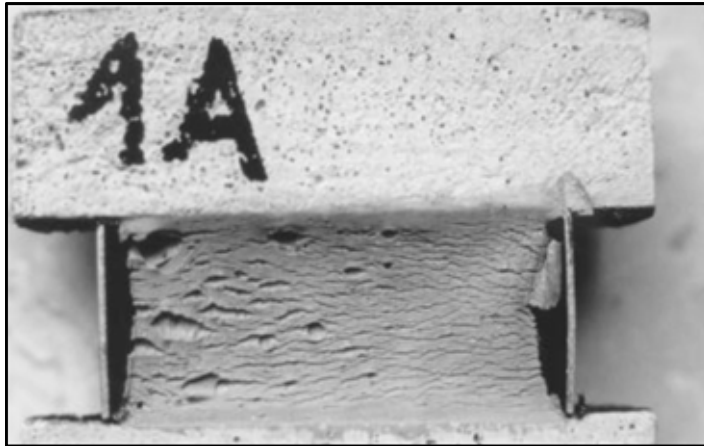


The Story is in the Sealant Surface

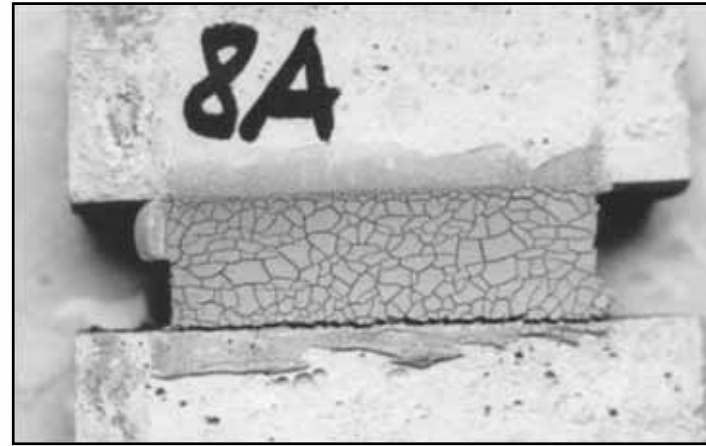
Can you identify these typical failures?



Aging/Weathering (Organic Sealants)



Polyurethane Sealant
Craze Cracking



Polysulfide Sealant
Mud Cracking

Edges of the sealant have bleached white

Color Shift (Exposure to the Sun)



Staining (Silicone)

Transmigration of Polymers



Staining (Polyurethane)



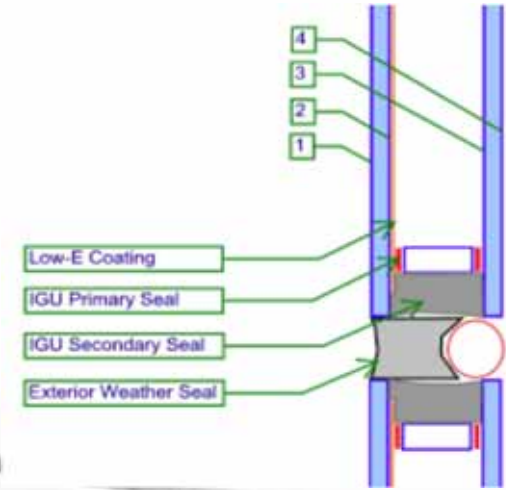
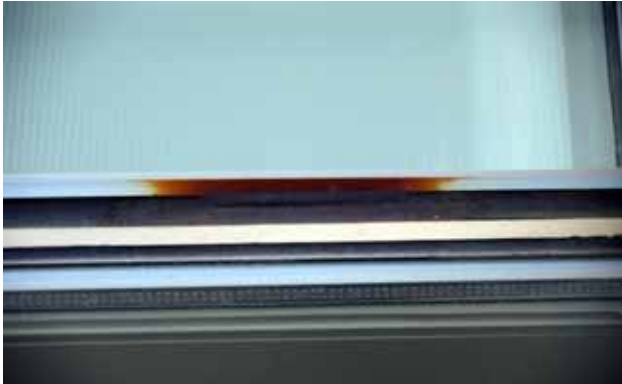
Using ASTM C-1248 Stain Test Method



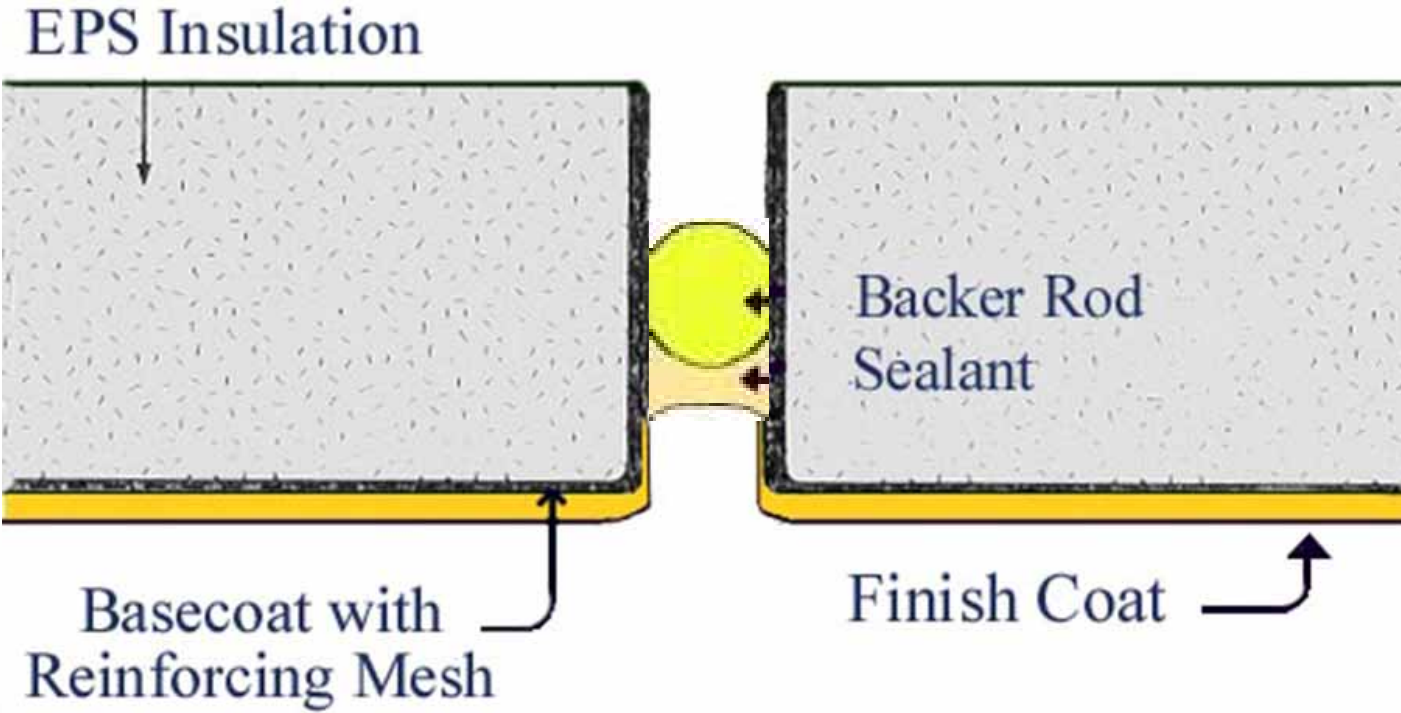
Indiana Limestone

Caused by organic
setting blocks

Plasticizer Migration & Sealant Staining

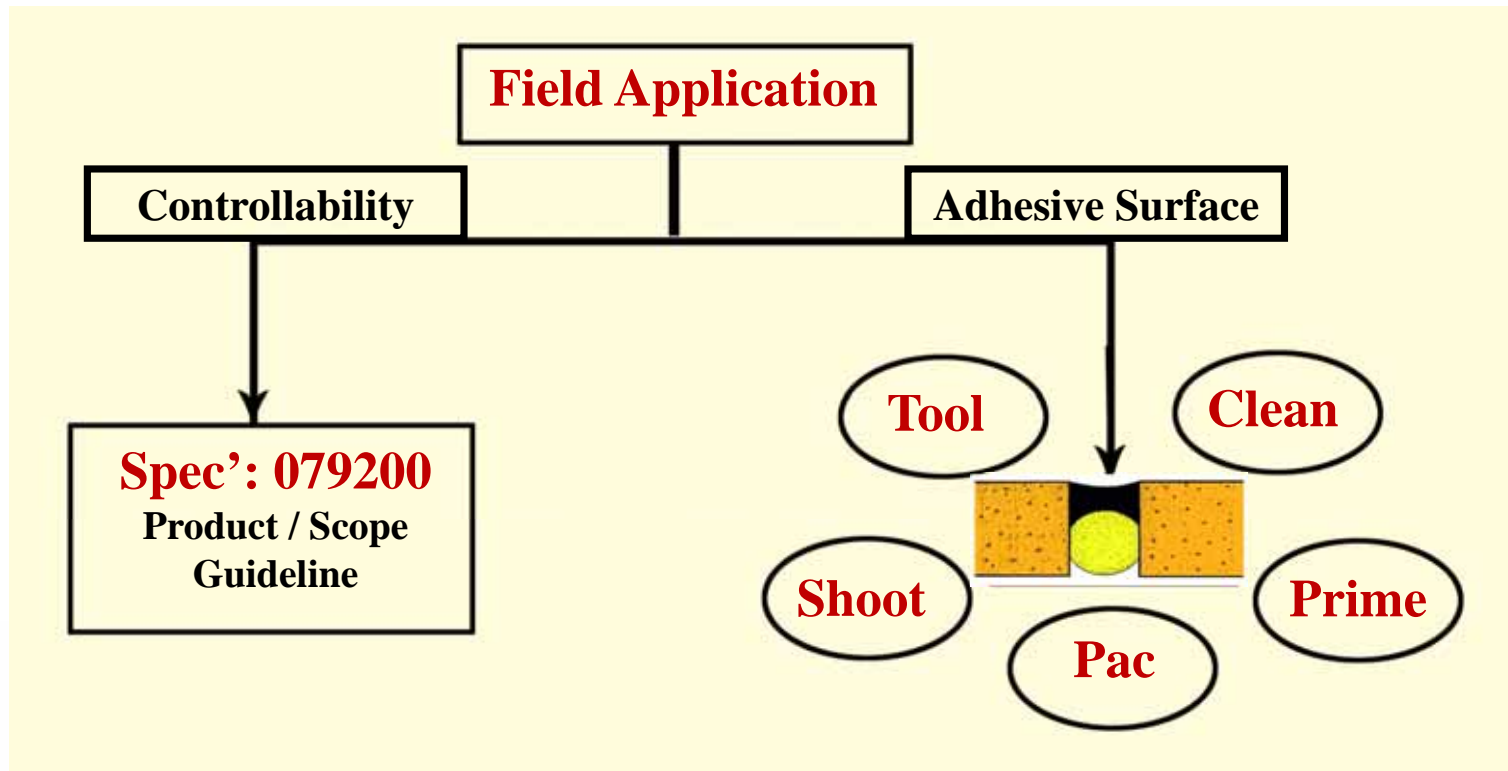


EIFS Joinery (Proper Location of Sealant Bead)



The Sealant Installer:

Qualified – Competent – Proficient – Accomplished – Knowledgeable



Facts:

***** To Avoid Application Defects *****

The Caulking Contractor is Responsible to:

- 1. Bring a Trained Crew to the Job Site**
- 2. Make Sure the Sealant Crew Follows Proper Installation Procedures.**
- 3. Proceed within all Specifications**

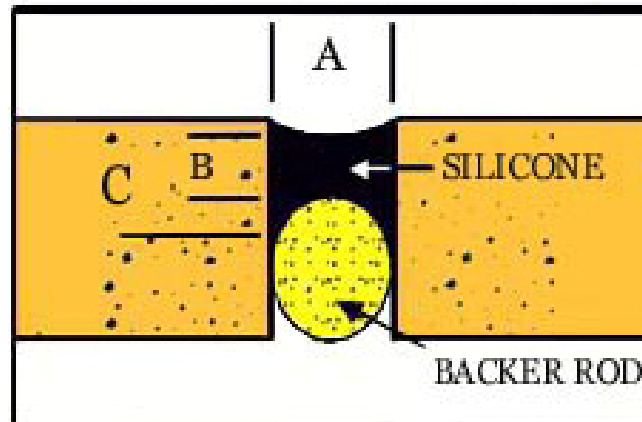
These simple requirements are insured through “Certification.”

Good Joint Design

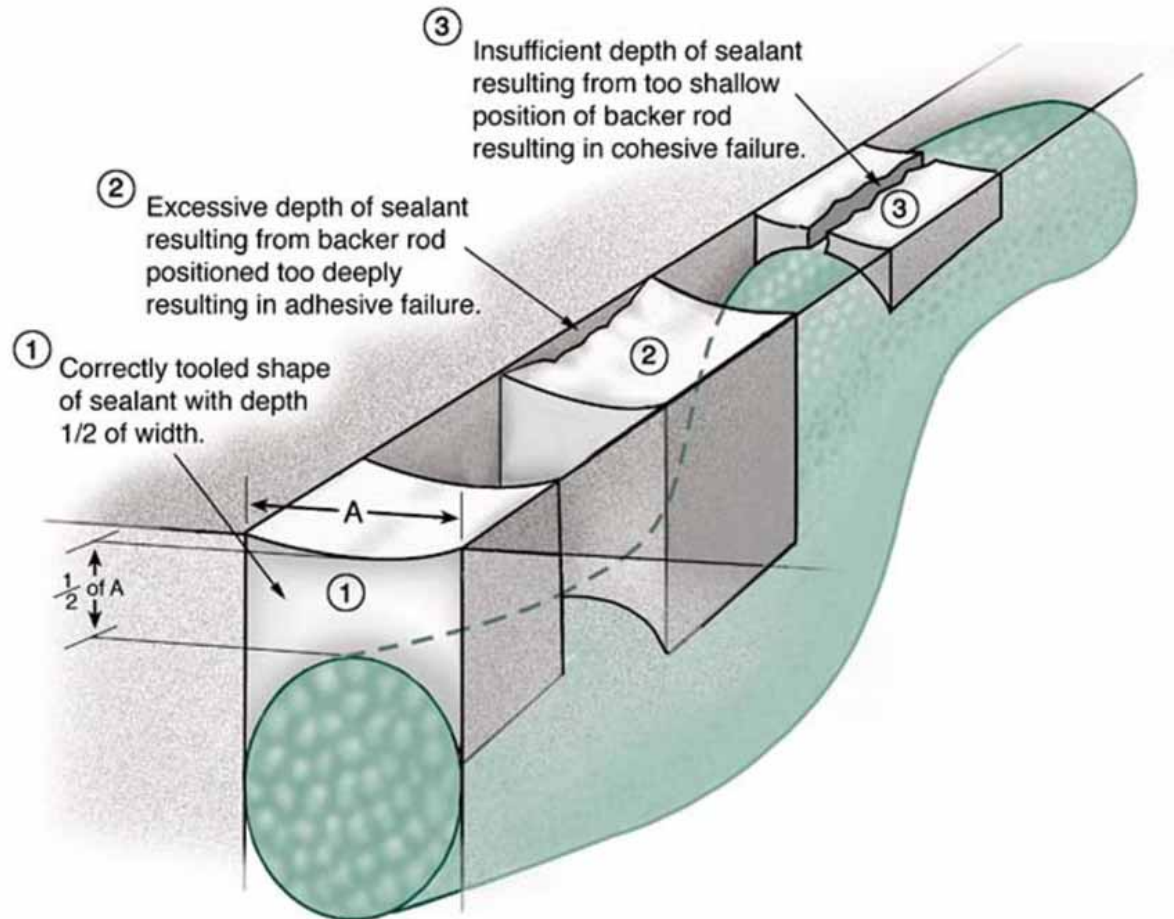
Key Points:

1. Dimensions C and A must be at least $\frac{1}{4}$ ".
2. Ratio of A:B should be 2:1 minimum.
3. Joint surface tooled concave.
4. Dimension B suggested maximum = $\frac{3}{8}$ ".
5. Dimension A maximum = 4" for most silicone sealants.

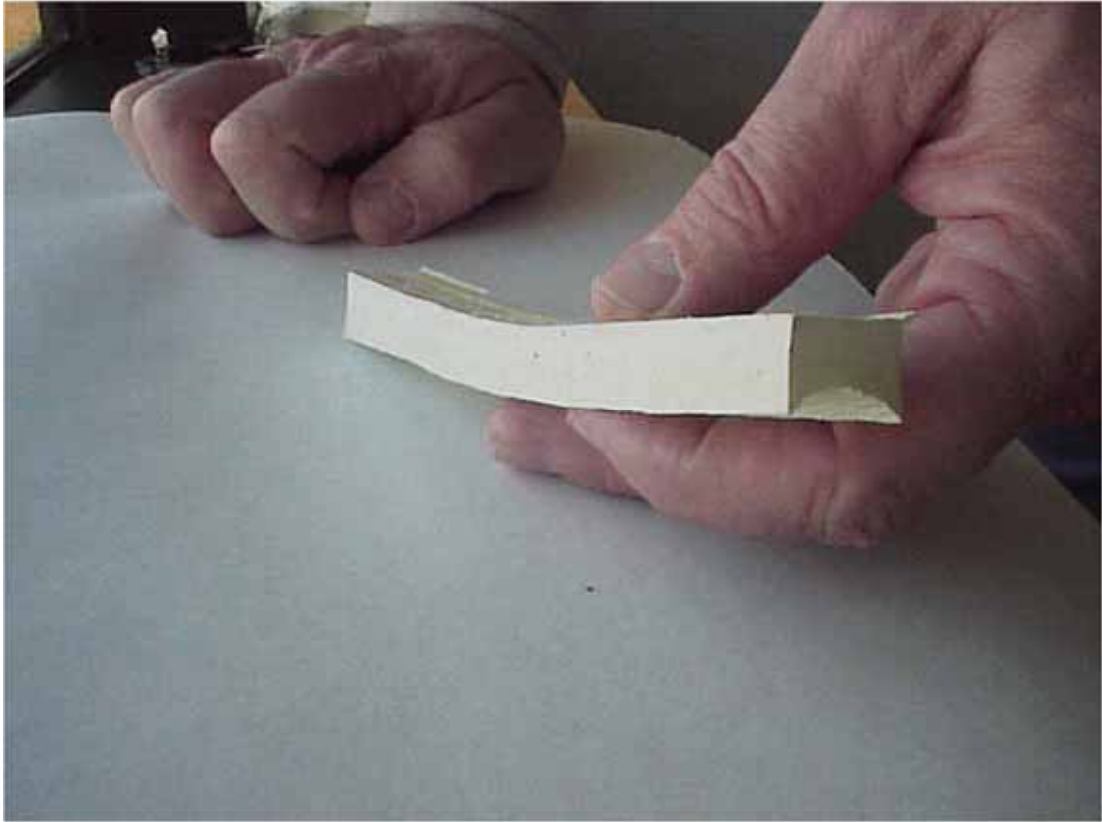
Good Joint Design



Purpose of Backer Rod



Look at the Cross-Section



Sealant Performance

***** Applicator Error *****

(Sealant too thin, backer rod is telescoping thru the Sealant Bead)



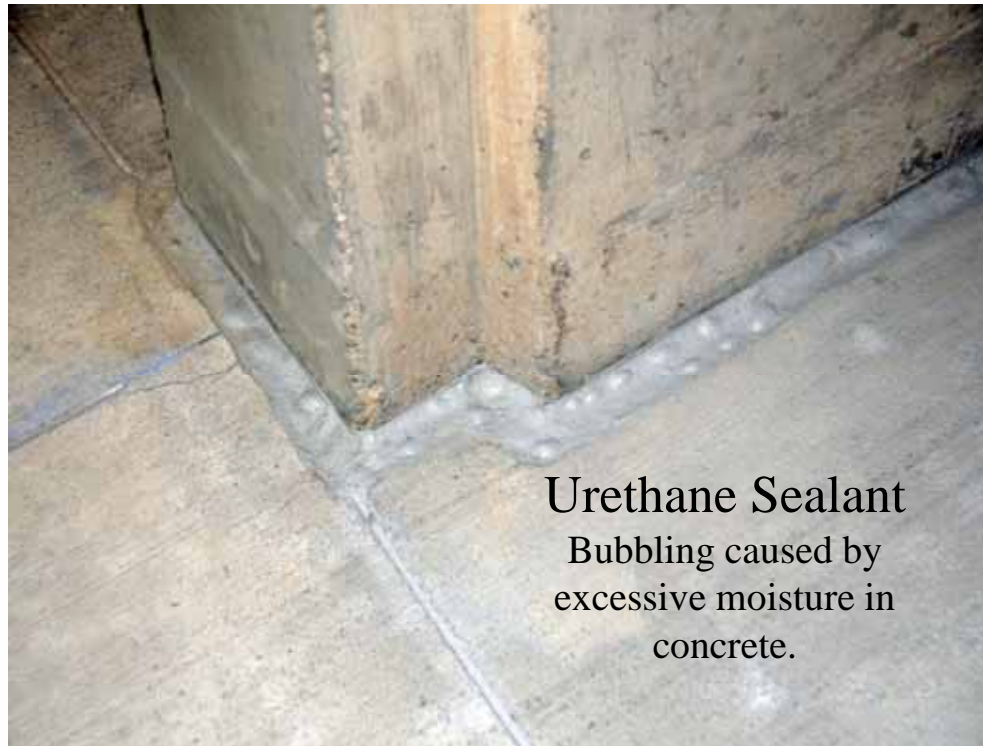
Aesthetic Issues

***** Construction Defects *****
(Masking tape caused this appearance)



Aesthetic Issues

(Applicator Error for not testing for moisture)



Urethane Sealant
Bubbling caused by
excessive moisture in
concrete.

Installation Issues

(Applicator Error)

Protect by installing a Mock Up first



Aesthetic Issues

(Is More Better?)



Aesthetic Issues

(Non-Certified Sealant Installation)



Proper Aesthetic

(Certified Installers Protect Your Projects)



Aesthetic Issues

(Bad tooling practice below)



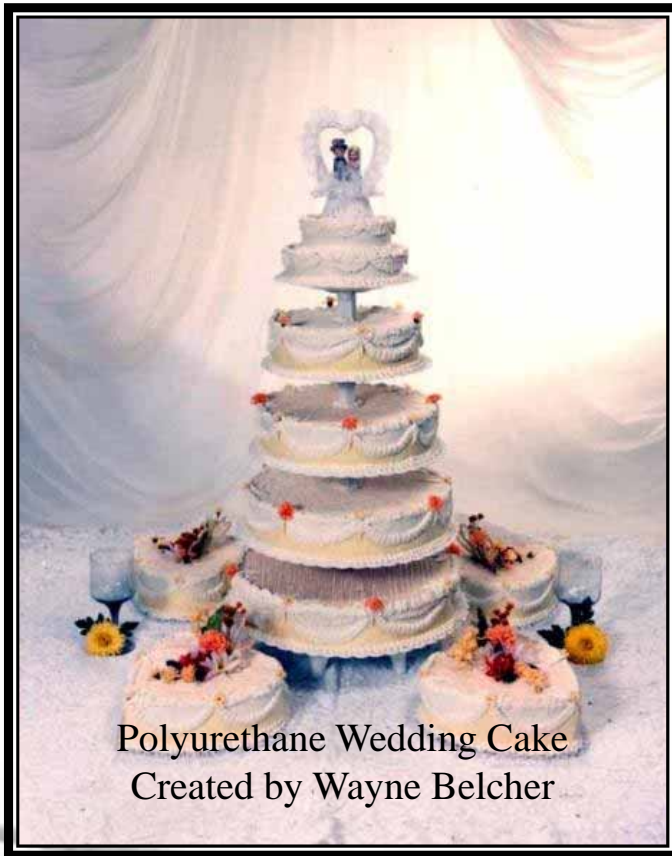
Proper Aesthetic

(Correct Tooling and Appearance)



Proper Aesthetic

(Why You Should Demand a Certified Installer)



Compatibility Issues

***** Failed Adhesion *****

(Foreign material must be removed from the bond line first)



Substrate Conditions Affecting Sealants

*** Tolerances & Adhesion ***

(Bushed concrete is not an acceptable surface for sealant application)



Substrate Conditions Affecting Sealants

*** Tolerances & Adhesion ***

(Bushed concrete is not an acceptable surface for sealant application)



Construction Site

(Dirty/contaminated surfaces can prevent proper sealant adhesion)



Substrate Conditions Affecting Sealants

***** Panel Alignment *****
(Construction Defect)



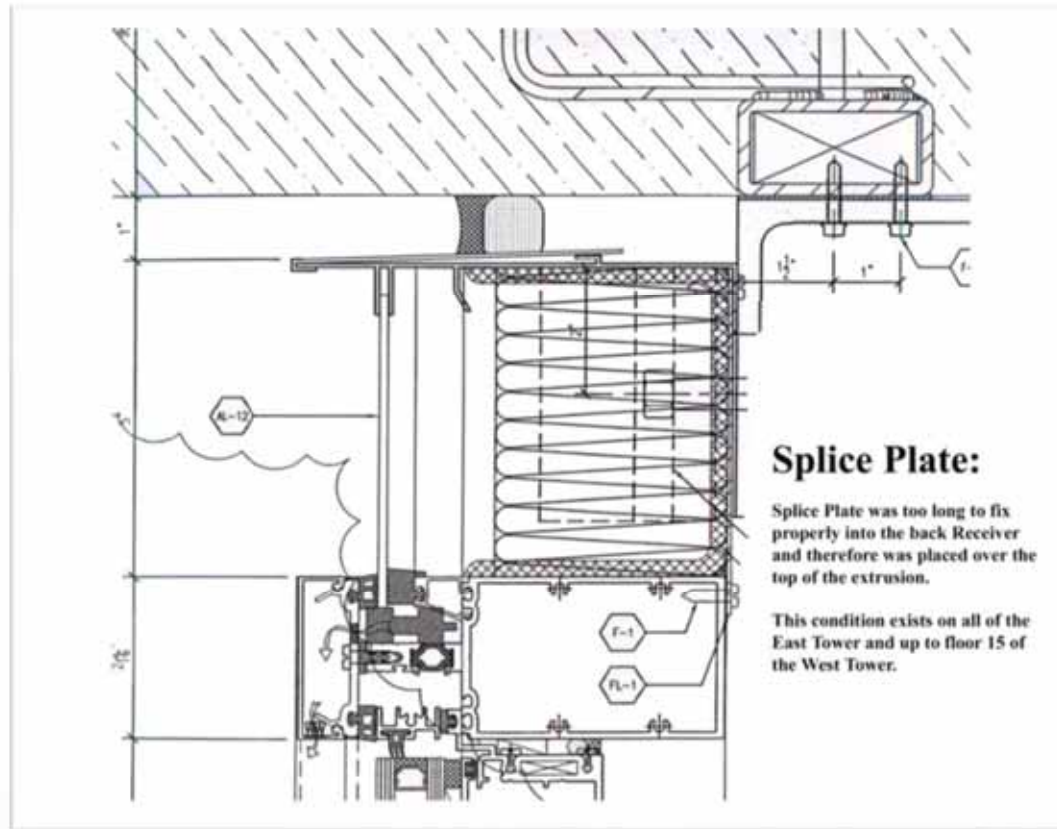
Sealant Performance Construction Tolerances (Disappearing Joint - Construction Defect)

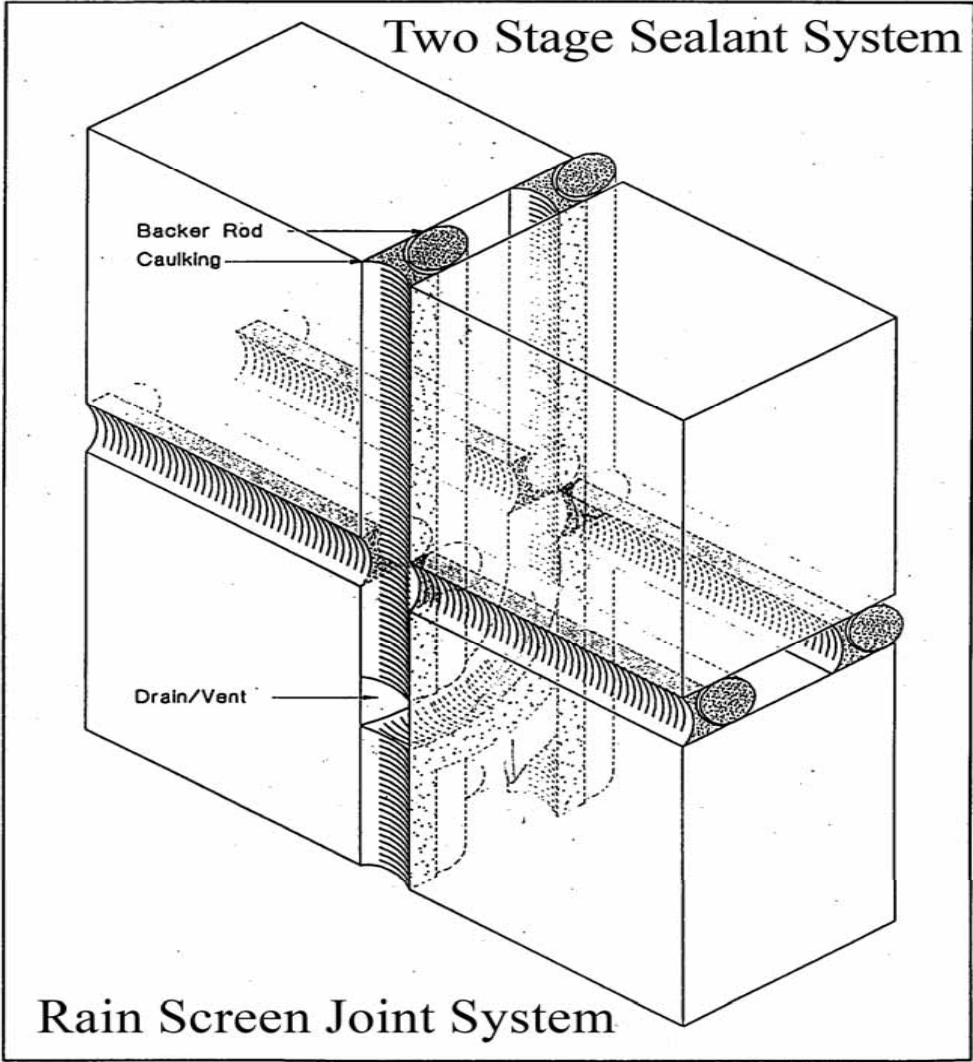




Sealant Performance

*** Construction Defects ***

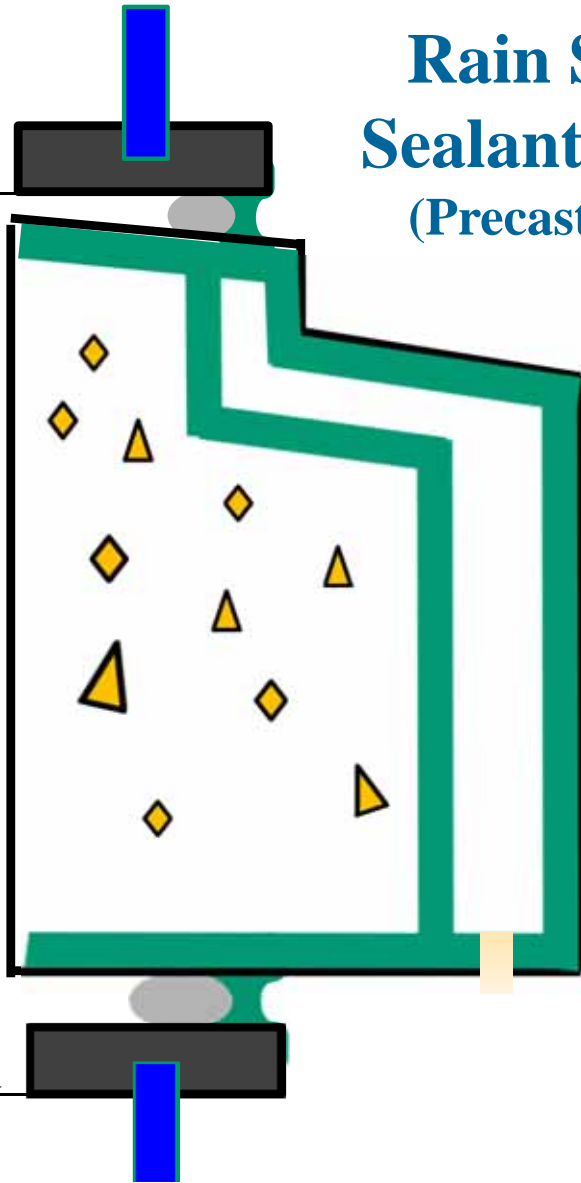




Rain Screen Sealant System (Precast Panels)

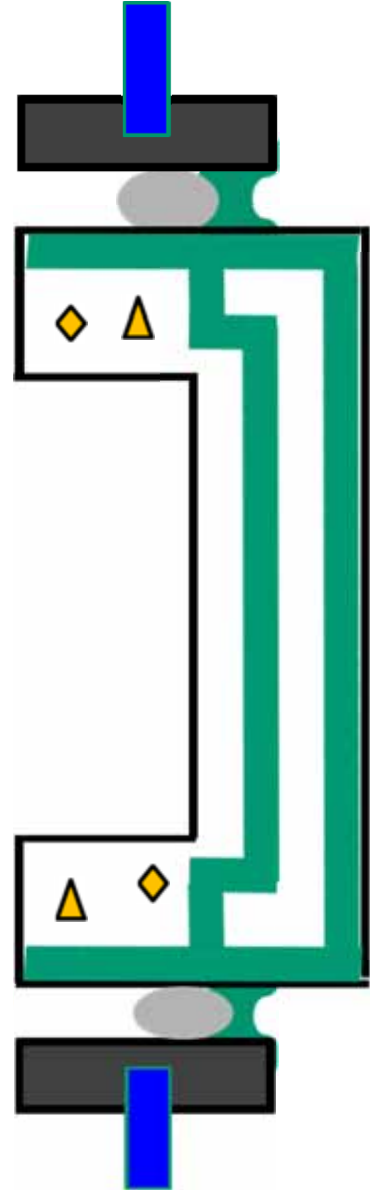
35th Floor Sill

S
P
A
N
D
R
E
L



34th Floor Head

C
O
L
U
M
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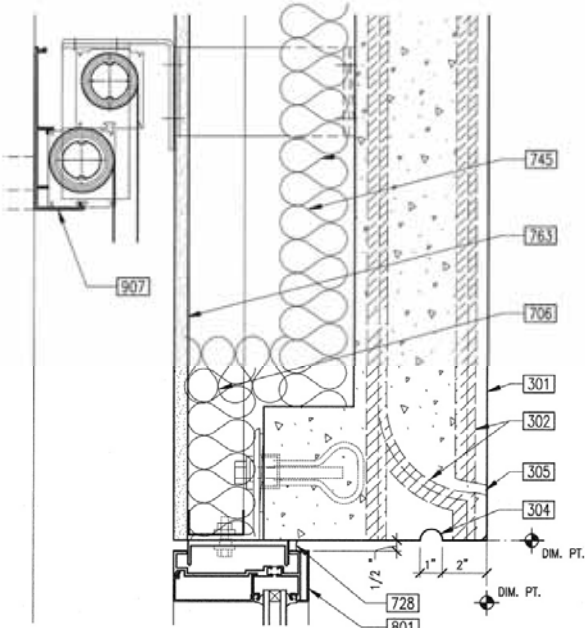


Rain Screen Sealant System

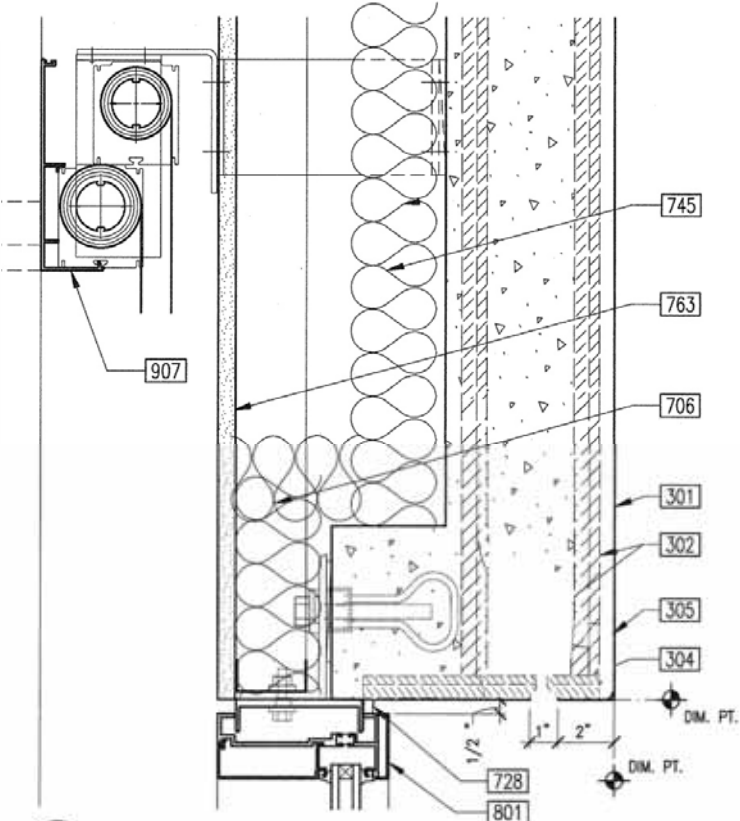
(Precast Panels)

Precast Sealant Must Connect With Window Sealant

As shown in drawing



16 WINDOW HEAD AT PRECAST
SCALE: 3" = 1'-0"
...\\07 2d drawings\08 ext\dell\precast\8B2004 WINDOW 4.dgn



16 WINDOW HEAD AT PRECAST
SCALE: 3" = 1'-0"
...\\07 2d drawings\08 ext\dell\precast\8B2004 WINDOW 4.dgn

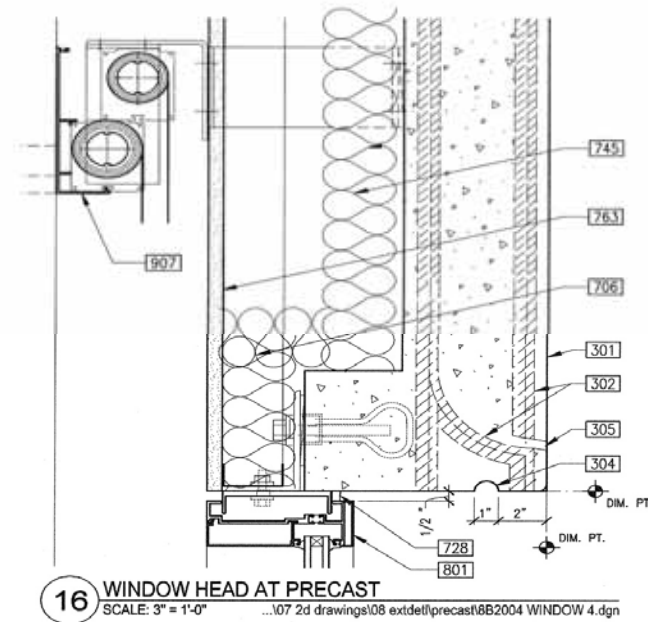


*** Construction Defects ***

(Plugged Weeps in 2-Stage Sealant Installation)



As shown in drawing



Placing silicone tape inside the joint first prevents the weep tube from blockage.

Sealant Performance

***** Best Practice *****
(Rain Screen Trough with Weep)



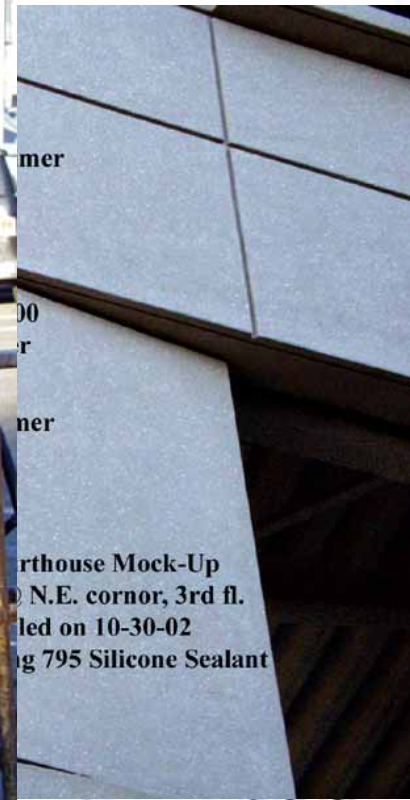
Applicator is adding solvent
to thin down the urethane.
Never recommended.

Sealant Performance

***** Construction Defects *****
(Misuse of Multicomponent Sealant)



On Site Adhesion Testing (Mock Ups)



Seminars / Instruction

(Making a Difference)

