



## Consumer Solutions



# Bringing Safety & Durability to incredible heights

Pınar Çetin, Glass Performance Days Turkey, 9<sup>th</sup> March 2018

# Content:

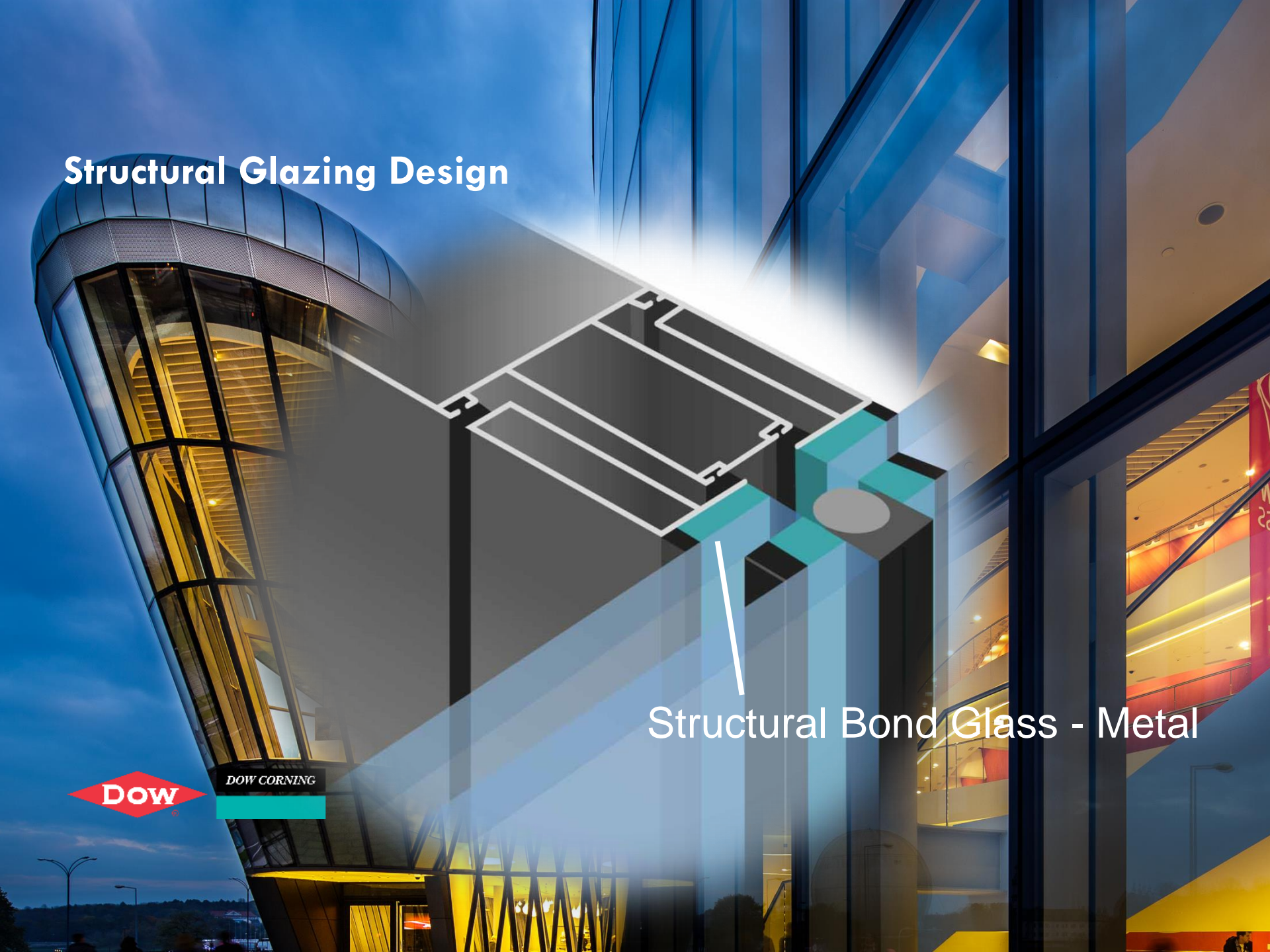
- Structural Glazing & Sealing – History, Benefits, Design
- Design Considerations
  - Durability of Sealants
  - Fire Safety Performance
  - Design Failures
- Quality of Application

# — Structural Glazing & Sealing

## History, Benefits, Design

# Structural Glazing Design

Structural Bond Glass - Metal



# Silicone Structural Glazing – History

**1964: First 2-sided  
SSG in US**



**1971: First 4-sided  
SSG „Grand Daddy”,  
Detroit**



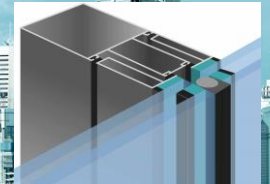
**1996: Protective  
Glazing SSG, UK**



**2010: 7.5kPa wind  
load SSG, Dubai**



**Proven Performance 50 Years +**



**DOW**

**DOW CORNING**



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## Structural Glazing Benefits

- Pure Glass Design
- Less Frame
- More Glass
- Higher Transparency
- Sleek flush facade skin
- Flowing designs



DOW CORNING

# Design Considerations

**Fire Safety**



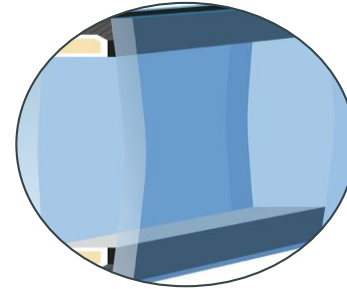
**Durability**



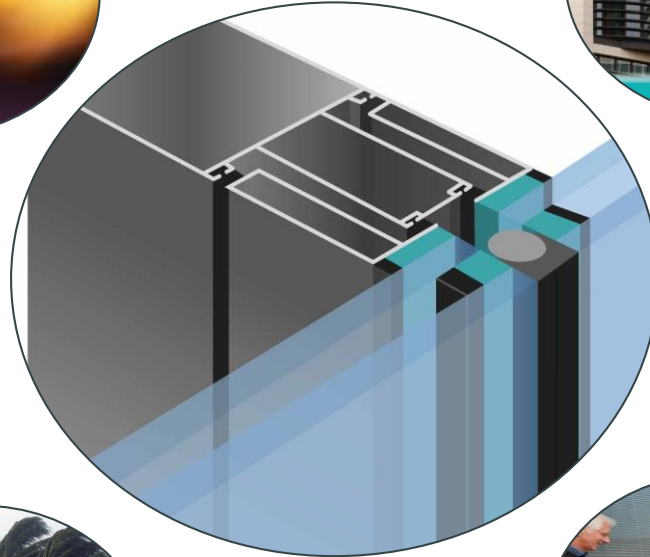
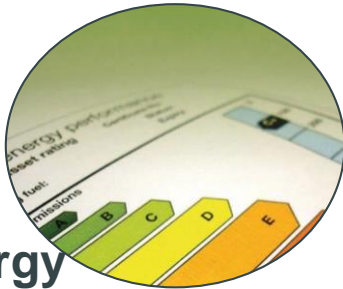
**Quality**



**Climatic Loads**



**Energy Efficiency**



**Expertise**



**High Wind**



**Bomb Blast**



# – Durability of Sealants

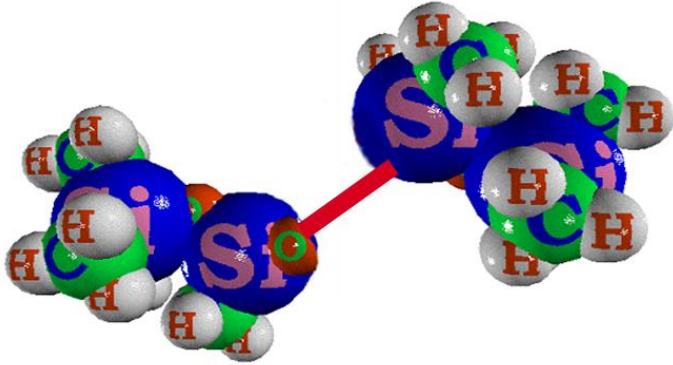


## ■ DURABILITY – important contributors

- **Sealant Longevity**
- Design
- Substrate Adhesion
- Compatibility
- **Quality of Application**

# Durability and Longevity: Why Silicones ?

Hybrid between inorganic (Silicon) and organic (Methyl) Molecule-Parts



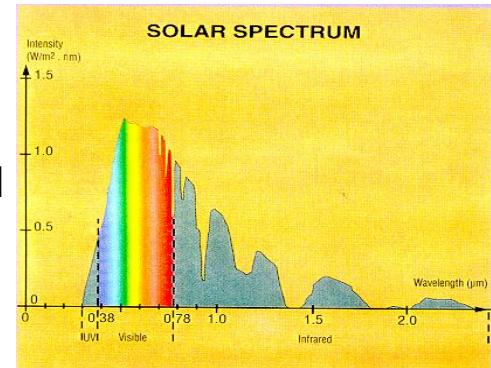
**Bond energy:**

**SILICONE: Si-O 452KJ/mol**

**Polyurethane: C-O 357KJ/mol**

**Polysulfide: C-C 360KJ/mol**

**UV  $\pm$ 400KJ/mol**



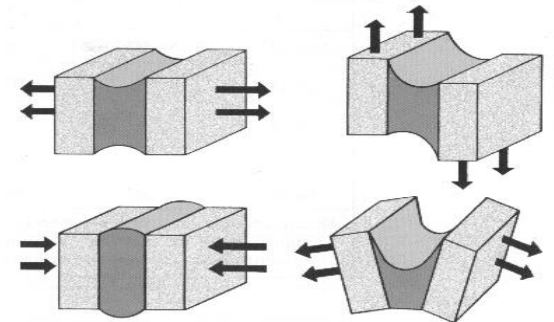
- Strong Si-O Bonding
- UV-Light Energy lower than Si-O-Si Bonding Energy
- Flexible Si-O-Chains

**High Strength & High Elasticity**

**UV-Resistant**

**Strong Chemical Bonds to Glass**

**High Temperature resistant**



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# Longevity of Sealants (RILEM-Test)

| Cycle    | Static Cure | Dynamic Cure |
|----------|-------------|--------------|
| 0 (Cure) |             |              |
| 1 Cycle  |             |              |
| 2 Cycles |             |              |
| 3 Cycles |             |              |
| 4 Cycles |             |              |
| Fatigue  |             |              |

Silicone

| Cycle    | Static Cure | Dynamic Cure |
|----------|-------------|--------------|
| 0 (Cure) |             |              |
| 1 Cycle  |             |              |
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| 4 Cycles |             |              |
| Fatigue  |             |              |

Polyurethane

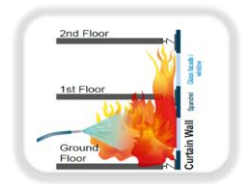
| Cycle    | Static Cure | Dynamic Cure |
|----------|-------------|--------------|
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| 2 Cycles |             |              |
| 3 Cycles |             |              |
| 4 Cycles |             |              |
| Fatigue  |             |              |

Polysulphide

**Silicones are superior in UV- and high temperature exposed applications**



# **Fire Safety Performance of Silicone Sealants**



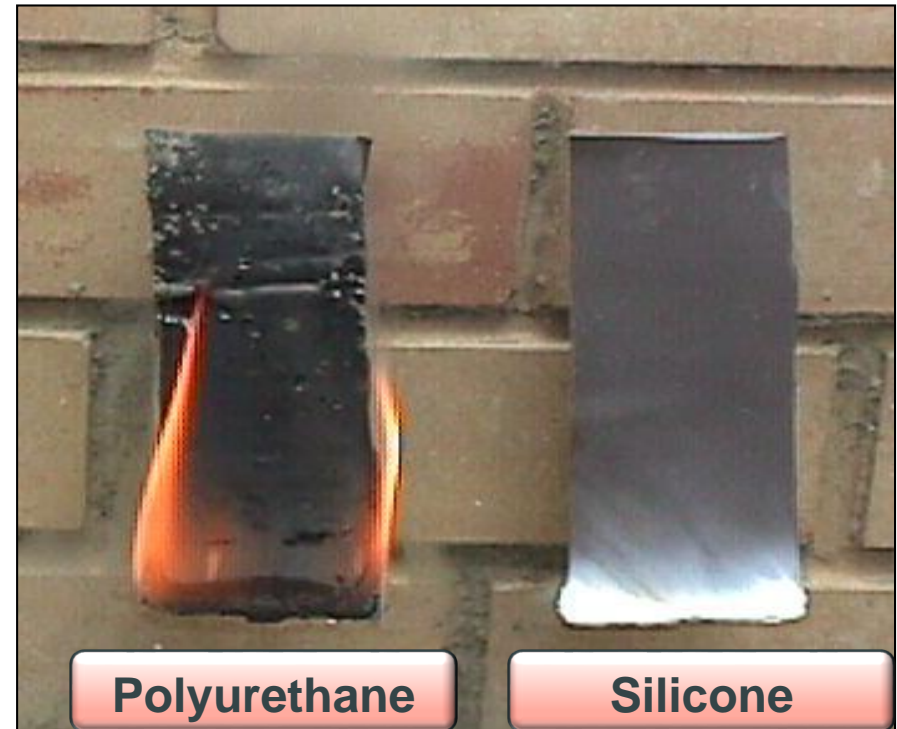
# Silicones in Fire Safety Applications

- **Silicone temperature resistance**

- -50° C to +150° C permanent
- Fire Seals (**DOW**):
  - +265° C and shortterm up to +315° C
  - 4 hours fire rating acc. to EN1366

- **Burning behavior:**

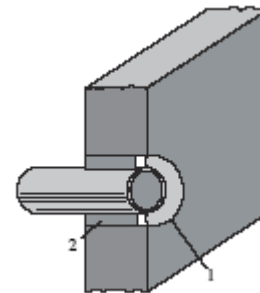
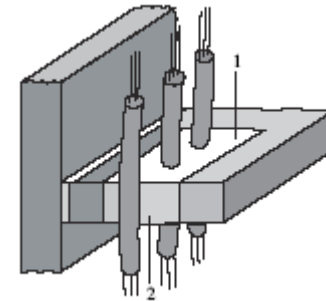
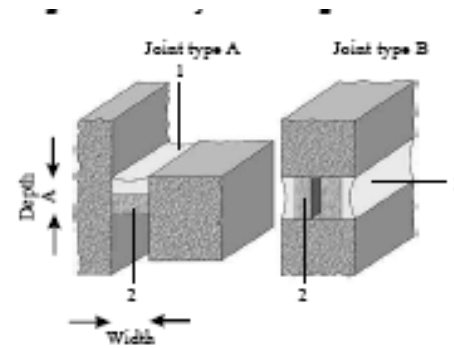
- Silicone sealants are **not flame propagating**
- Silica powder is extinguishing the flame
- Released VOCs are non-odor and non-toxic

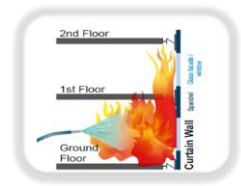


**Silicones can NOT be categorized as non-flammable as they are not inorganic**  
**Silicones provide excellent fire retardant properties compared to other sealants**  
**For fire-safety consideration, the whole system has to be tested**

## Typical Applications

- Floor-wall connection: Smoke-Seal
- Interior and exterior joints
- Cable penetration Seal
- Pipe penetration Seal





## Example of performing silicone in a façade system

Fire outside building  $T > 800^{\circ} \text{C}$

- Glass Broke
- Aluminium melted
- Silicone kept its adhesive properties
  - Elasticity
  - Did not burn
  - Adhered to and protected the substrate



## Existing European Norms and guidelines

- ETAG 026 – Fire Stopping and Fire Sealing Products (part 1, 2 and 3)
- ETAG 028 – Fire retardant Products
- EN 1366
  - Parts 1 to 7 – Fire Resistant Tests for service installation
  - Part 3 - Fire Resistant Tests for service installation penetration seal
- EN 1364 – Fire Resistance tests for non-loadbearing elements
- ISO 834 – Fire resistance tests
- Potential local norms to be considered

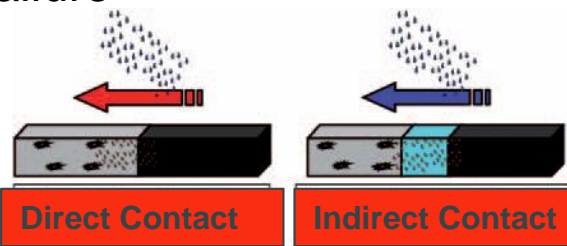


# Design Failures

Compatibility & Sealant choice

# Why Sealants Joints Fail

- **Adhesion Performance:**
  - Adhesion NOT tested prior to use
  - Improper surface preparation (dust-free, oil-free)
  - Lack of primer or wrong primer
  - Moisture – wet substrate
- **Application:**
  - Poor joint filling, tooling
  - Wrong / No Baker rod
  - Wrong Sealant choice
  - Joint dimensions not considered
  - Application temperatures ( $>+50^{\circ}$  C)
  - etc.
- **Compatibility**
  - Materials in direct or indirect contact must be tested prior to use to avoid whole system failure



## Delamination – laminated glass



**Plasticizer Migration  
Sealant to laminate & Laminate to sealant**

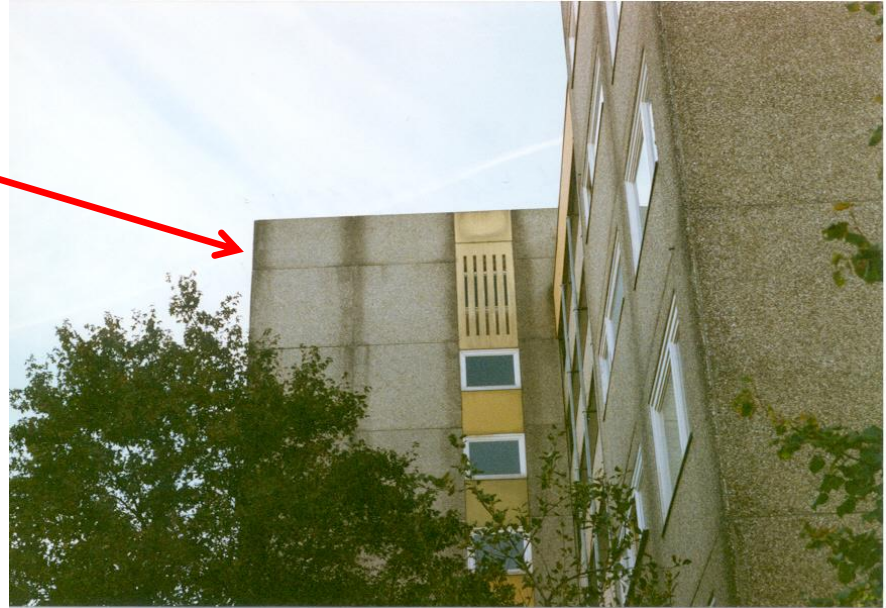
# Incompatible Setting blocks

Setting blocks in contact with fire rated laminated glass: Plasticizer migration from one setting block to the other



# Staining in natural and artificial stone applications

Diluted Silicone with organic plasticizer caused staining

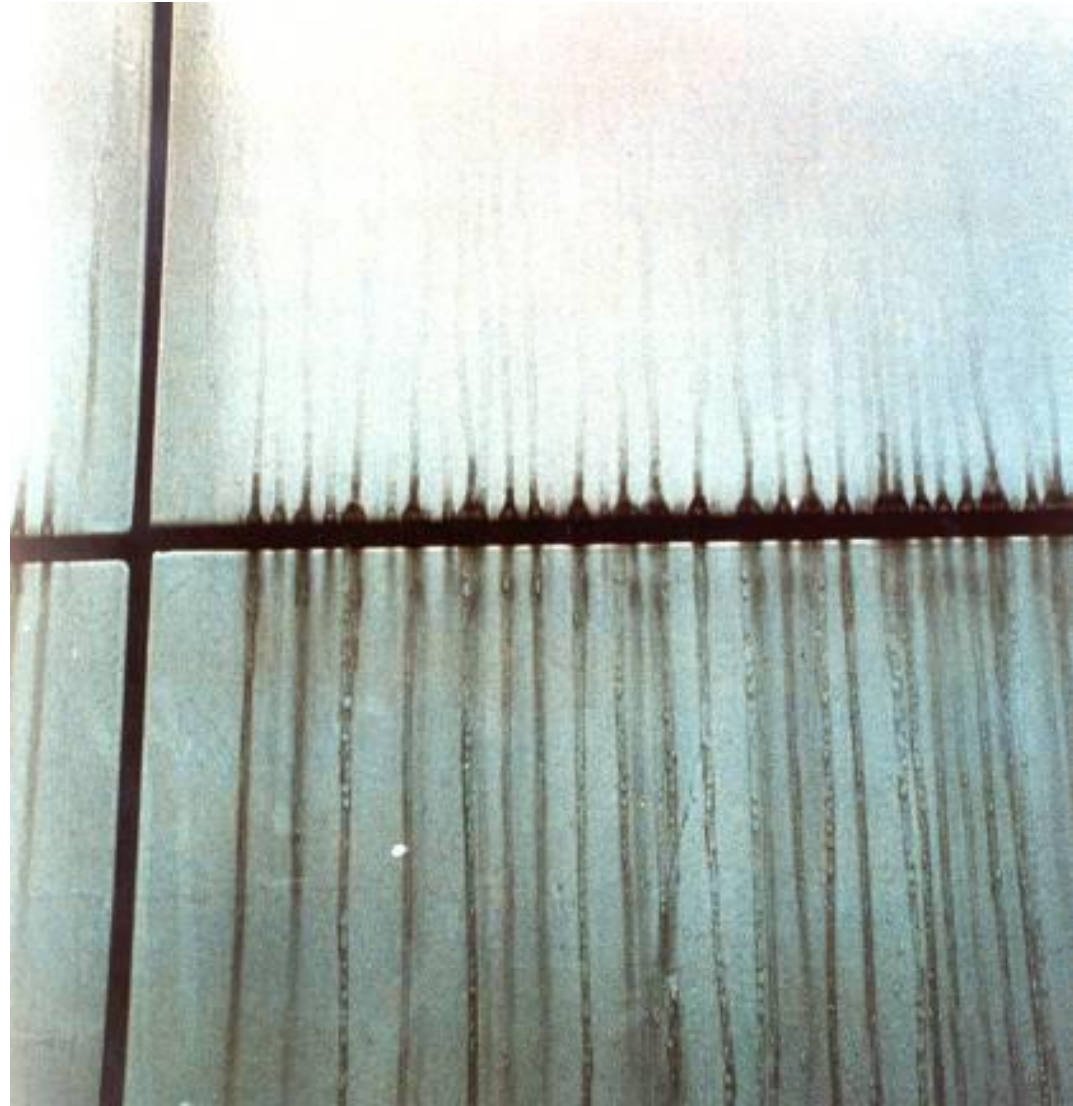


Staining in marble applications – plasticizer free sealants have to be used



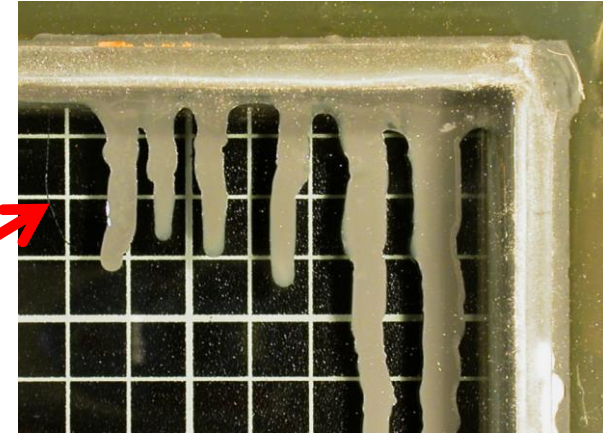
# ■ Streaking

- Dust & Dirt traces from rain over time
- Avoid streaking with a „clean“ plasticizer free sealant
- Diluted sealants with organic oils increase streaking

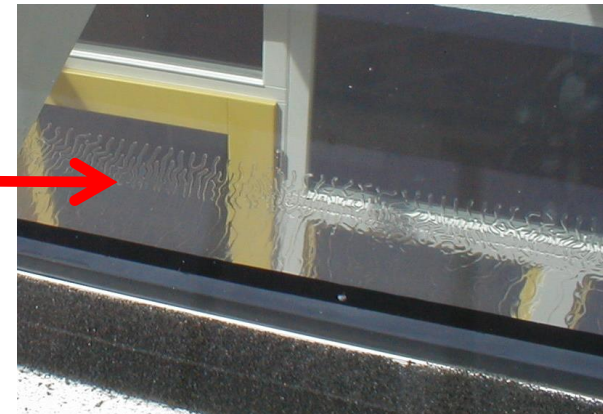


## Other design failures

- Butyl dissolved from plasticizer – incompatible weathersealant : indirect contact through IG secondary seal



- Delamination due to incompatibility: Highly diluted sealant has been used



# ■ Butyl (PIB) Failure

**Setting blocks fixed with highly diluted sealant containing mineral oil as plasticizer**





# Insulating Glass with Alu-Spacer

Adhesion loss between secondary sealant and spacer due to incompatible weather sealing



## Glass: soft coating without edge deletion



**no or poor edge deletion of soft coating  
has cause adhesion failure of secondary  
sealant**

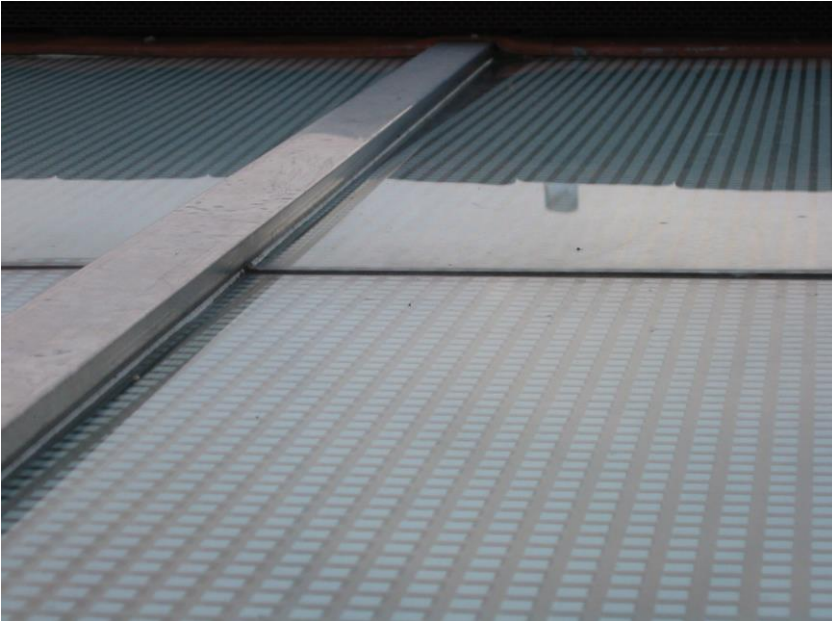
## ■ Non-UV resistant secondary sealant

Organic sealant used in UV exposed designs:  
adhesion failure, moisture penetration, risk of  
glass falling down in facade application



## Cross section exterior facade

Horizontal profile with EPDM gasket in contact with vertical weather sealing. Incompatibility led to untightness of whole facade skin



## Weather Seal: damaged baker rod

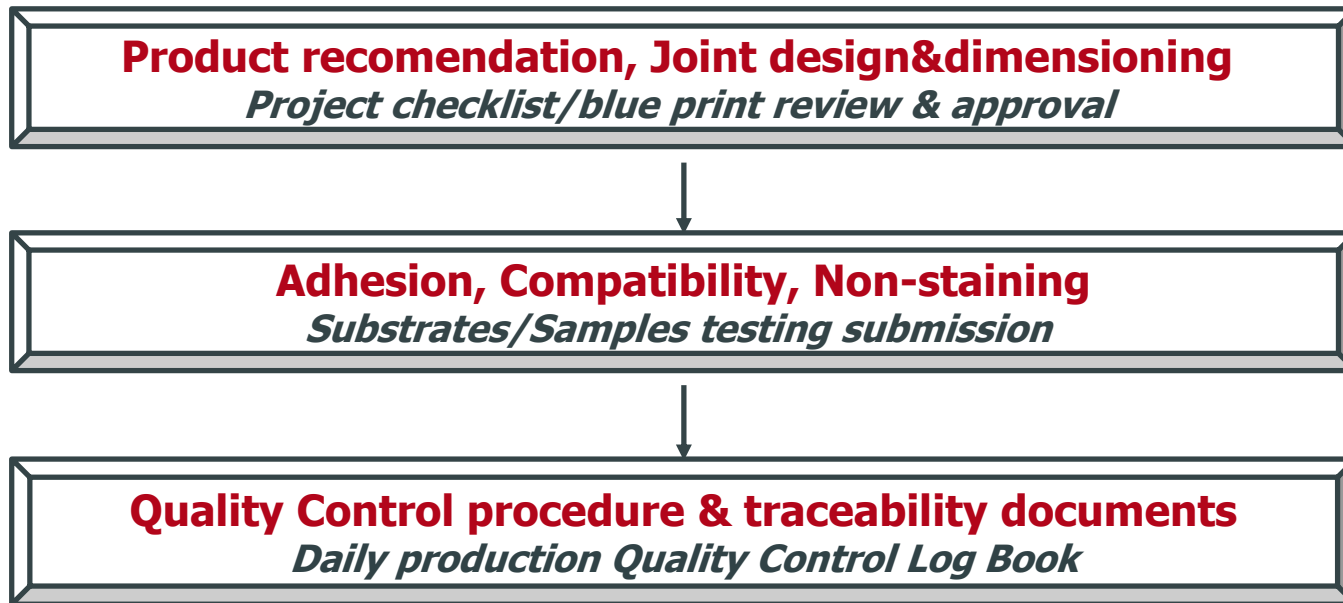
Closed cell PE baker rod has been damaged. Outgazing led to bubbling of uncured sealant



# Example of Quality Assurance

## Quality Control process

*(DOW SG/IG Manual ETAG-002 and/or EN 1279)*

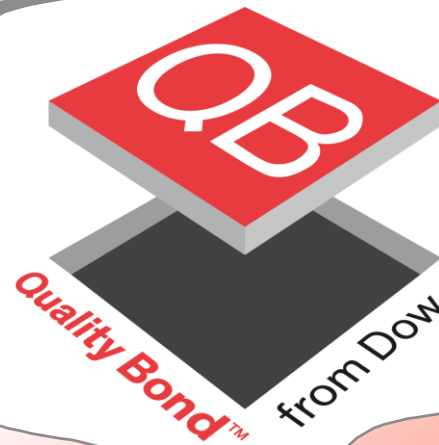


# QUALITY BOND™ PROGRAM

Track / Monitor / Control application quality

*Blue print review;  
drawings, system types,  
substrate origin...*

*Joint design and project  
approval letter*



*Laboratory substrate  
preparation letter and  
any compatibility test  
confirmation.*

*Daily production Quality  
Control Log Book*



# Thank You

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