Assessing Curtain Walls

Considerations and Best Practices

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What is a Curtain Wall System?

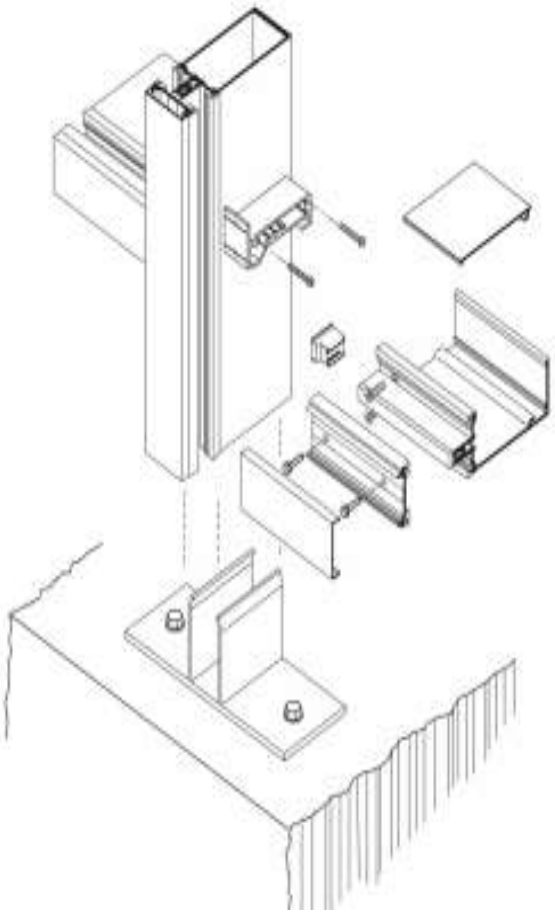
- A **curtain wall** system is an outer covering of a building in which the outer walls are non-structural, but merely keep the weather out and the occupants in
- This presentation will focus on glass curtain walls, which often span multiple floors
- In the glazing industry – curtain wall often refers to the type of framing system, rather than the application

Types of Curtain Wall Systems

- Stick Systems
- Unitized Systems
- Conventionally Glazed Systems
- Structurally Glazing Systems

Stick Systems

- Stick Systems, where the framing is typically installed in long pieces vertically and between vertical members horizontally. Framing members may be fabricated in a shop, but installation and glazing is typically performed at the jobsite.



Unitized Systems

- Unitized curtain walls are typically factory fabricated and glazed. These completed units are hung on the building structure to form the building enclosure

Conventionally Glazed Systems

- Conventionally glazed systems typically utilize gaskets and sealants between the glass and framing
- Any water that penetrates the exterior of the system is supposed to be collected and drained back to the outside.
- These types of systems can be stick or unitized.

Structurally Glazed Systems

- Structurally glazed systems utilize structural silicone to adhere the glass to the frame.
- Often they have no exterior framing.
- These systems usually are unitized and factory glazed.
- Since the silicone is the only thing keeping the glass in the frame, clean factory conditions and rigid quality control are essential.
- These systems are designed to deflect all water at the exterior surface.

Window Walls

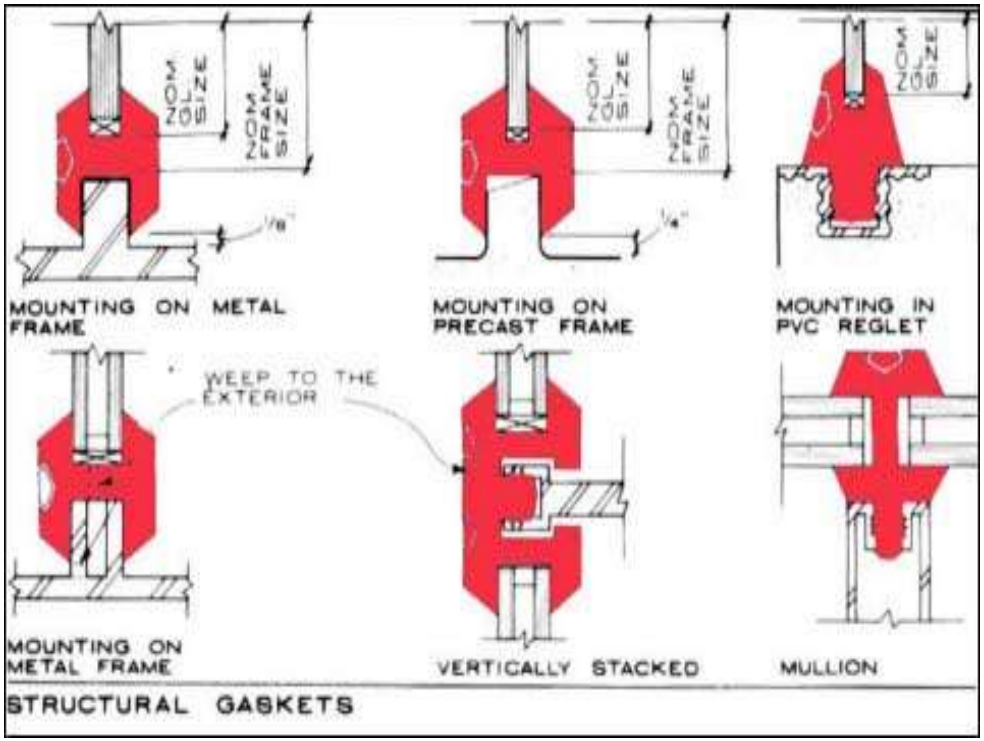
- Curtain wall framing is often used in other glazing applications
- Floor to ceiling windows – slab to slab
- Window walls can look like curtain walls
- Slab covers can make a window wall look like a curtain wall

Materials

- Framing
- Glass
- Sealants and Accessories
- Anchors
- Other Infills

Framing Types

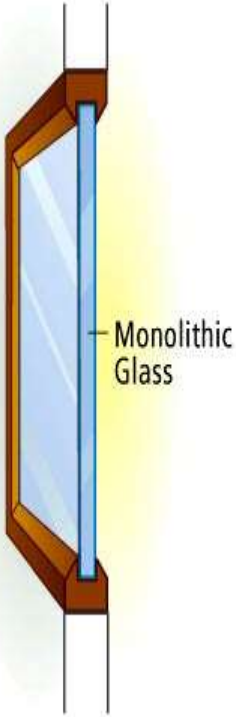
- Aluminum (typical)
- Steel
- Wood
- Composites
- Gaskets

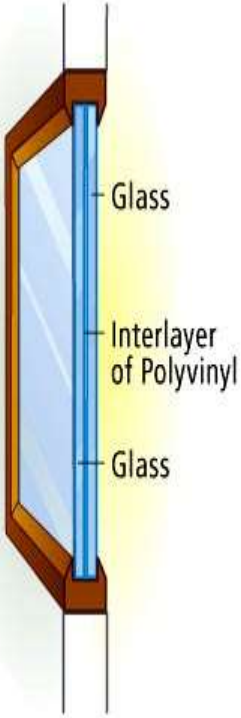


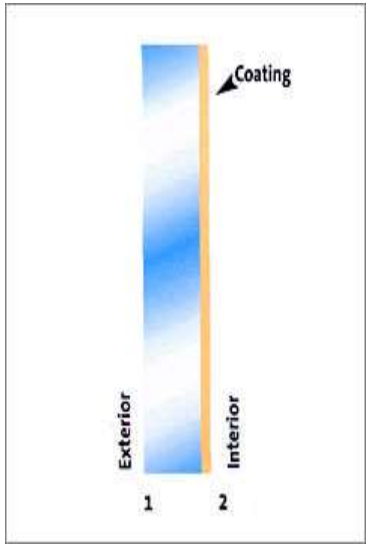
Glass Types

- Monolithic (a single light of glass)
- Heat treatment (tempered or heat-strengthened)
- Insulated (two lites of glass with a sealed airspace in between)
- Laminated (two lights of glass bonded together with an interlayer)
- Spandrel (glass with a coating on the back to cover construction materials)

Glass Types


Monolithic
Glass

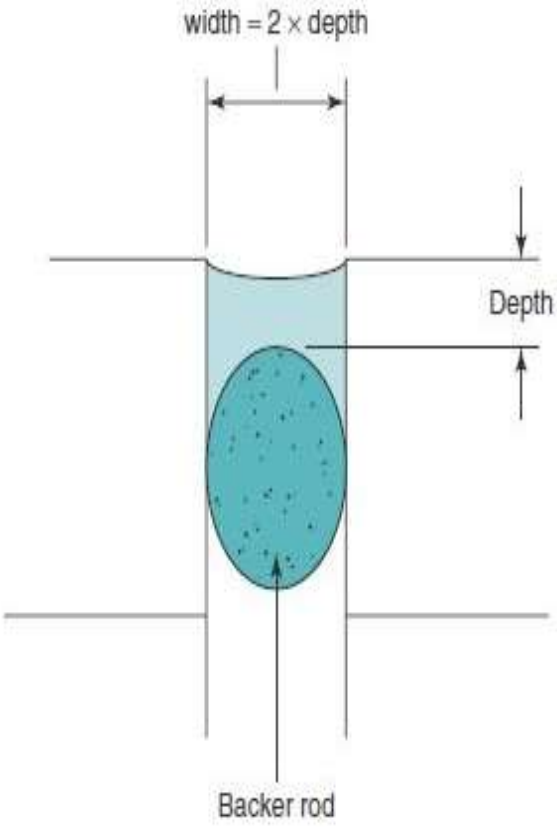

Glass
Interlayer
of Polyvinyl
Glass


Coating
Exterior
Interior
1
2

Glass Types – Identification

Sealants

- Internal – used as part of the curtain wall system design
- Perimeter – used between the curtain wall system and surrounding surfaces
- Wet seals – after the fact remedial sealants normally used in a attempt to halt or slow water leakage

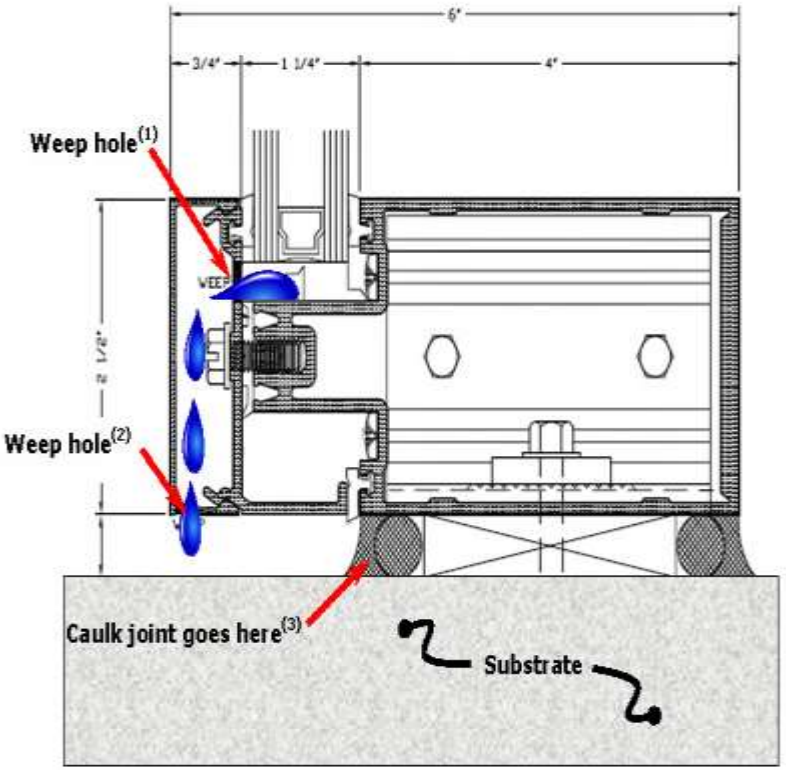


Common Sealant Types

- Silicone
  - Considered the best construction sealant and also more expensive
  - Withstands high temperatures
  - Warranties up to 20 years on material
  - UV stable
- Polyurethane
  - Commonly used for perimeter sealants
  - Less expensive
  - Warranties typically five years
  - Needs UV blockers
  - Better adhesion that silicone

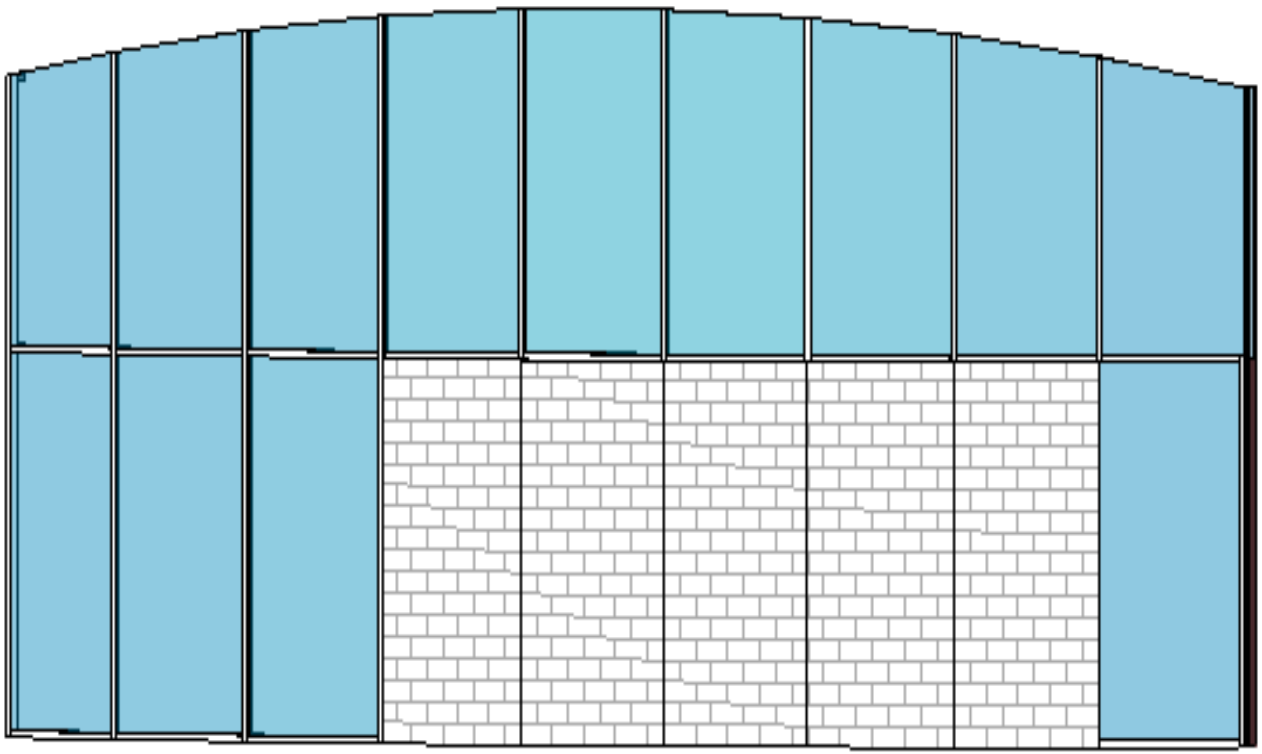
Accessories

- Glazing Gaskets
- Glass Setting Blocks
- Zone Dams or Joint Plugs
- Covers
- Trim
- Flashing



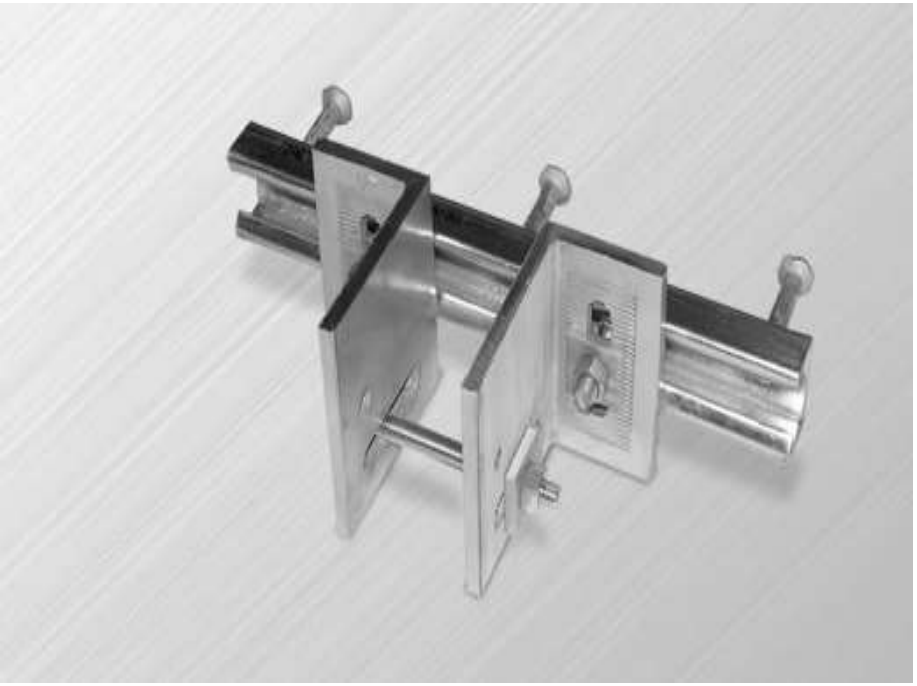
Other Infills

- Stone
- Panels



Anchors

- Types
- Location
- Access



Assessment Process

- Gather Project Information
- Conduct Assessment
  - Level 1
  - Level 2
  - Level 3
- Analyze Data
- Deliverables

Level 1 Assessment

- Non invasive study
- Review project documents
- Review service and maintenance records
- Interview building management and users
- Visual observations

Level 1 Assessment – Review Project Documents

- Plans and Specifications
- Shop Drawings
- Submittals
  - Manufacturers Literature
  - Test Reports
  - Product Approval Documents
  - Engineering Calculations

Level 1 Assessment – Service History

- Interview Project Stakeholders
  - Building Management
  - Maintenance Personnel
  - Building Occupants and Users
- Review Service and Maintenance Records
- Review Weather Records for Prior Extreme Events
  - Windstorms
  - Seismic
  - Flood

Level 1 Assessment – Visual Inspection

- Walk around Interior Inspection
- Walk around Exterior Inspection
  - Ground
  - Balconies
  - Roof
  - Adjacent Buildings
- Inspection from Boom Lifts and Swing Stages (optional)

What to Look for – General

- Interior Water Damage
- Aging
- Corrosion or Deterioration of Framing and Anchors
- Signs of Distress
  - Misalignment
  - Bulging
  - Discoloration
  - Staining Patterns

What to Look for – Framing

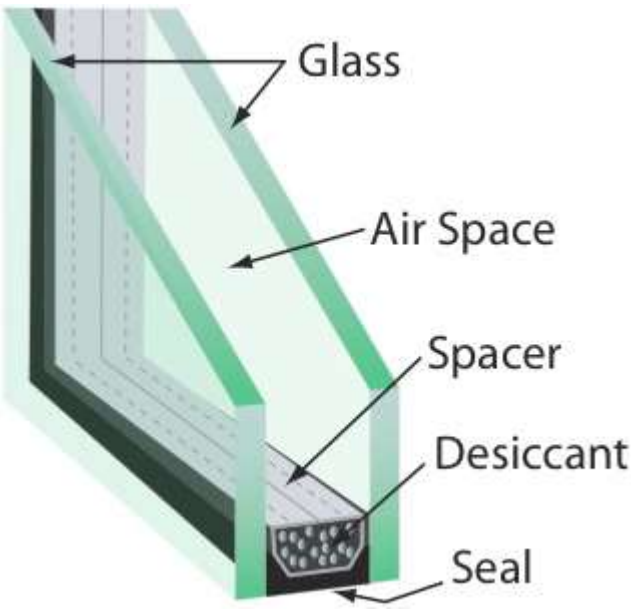
- Age and Condition
- Distress
- Paint Finish Condition

What to Look for – Glass

- Identify glass types
  - Heat treatment
  - Insulated
  - Laminated
- Age and Condition
  - Scratches
  - Damage
- Distress
  - Broken glass
  - Fogging
  - Visual imperfections
- Installation
  - Glass Bite

Insulated Glass

- Insulated glass is defined as two or more lites of glass with a sealed airspace in between
- Insulated glass is commonly sold with a ten year (or less) manufacturer's warranty that the seal between the glass will be maintained.
- Once insulated glass gets to twenty years old, it is nearing the end of it's useful life
- The only viable way to remedy seal failure is to replace the glass
- Insulated glass units often contain markings on the spacer between the glass indicating a manufacturer code and the date of manufacture

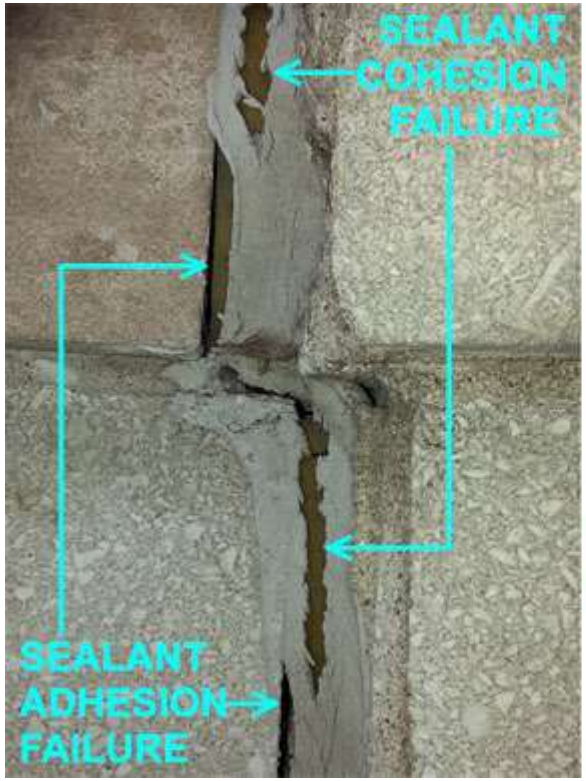


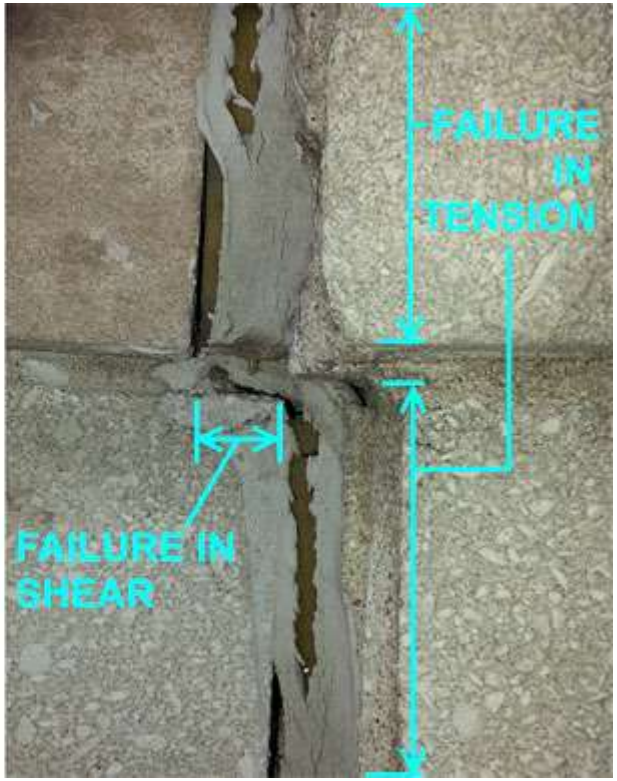
What to Look for – Weatherstripping

- Age and Condition
- Length
- Missing?
- Falling out?
- Hardness
- Wet Sealed?

What to Look for – Sealants

- Type
- Age and Condition
- Sealant Failures
- Wet Seal?





Wet Seal

- A wet seal is an after the fact sealant application often applied in an attempt to reduce or halt water intrusion
- Wet sealing changes the design concept of glazing systems from collect and drain to barrier
- To be effective – everything must be sealed properly – glass to metal, metal to metal, and perimeters
- Wet sealed systems must be 100 percent effective or any water entry will be trapped, since there are no provisions for drainage
- Water entry from adjacent areas will be trapped in the system
- Wet sealed systems must be regularly inspected and maintained

What to Look for – Anchors

- Most anchors are concealed and not able to be inspected during a visual walk around
- Typically glass or interior finishes must be removed to view anchors
- Look for signs of distress, such as cracks, gaps, separations, broken glass, misalignment or bulging
- Look for signs of corrosion and aging, if possible.

What to Look for – Surrounding Surfaces

- Look for water entry from other areas into the glazing system
- Walls and Cladding
- Roofs
- Parapet Caps
- Balconies

What to Look for – Regional Considerations

- Extreme Climates – Hot or Cold
  - Glass failure
  - Sealant failure
- Windstorm damage – Hurricanes and Tornados
  - Bent or damaged framing
  - Damaged anchors
  - Distress – gaps, separations, misalignment, bulging, etc.
  - Glass Damage – cracks, scratches, misalignment in frame, loss of seal to frame
- Seismic Damage
  - Distress– gaps, separations, misalignment, bulging, etc.
  - Glass Damage – cracks, scratches, misalignment in frame, loss of seal to frame
- Flood Damage
  - Water damage and mold

Level 2 Assessment

- All of Level 1 activities, plus:
- Selected disassembly of glazing systems
- Destructive analysis of cladding systems
- Analysis of anchors and fasteners
- Field water infiltration tests

Level 2 Assessment – Selected Disassembly

- Further investigation of issues found during Level 1 Assessment
- Hire a local glazing contractor to assist
- Generally involves glass removal for inspection of concealed conditions
- Sometimes involves removal of interior or exterior finishes
- Always have a plan to restore to pre-inspection conditions

Level 2 Assessment – Analysis of Anchors

- Generally requires removal of glass or interior/exterior finishes
- Look at overall condition of anchors – corrosion
- Check condition of fasteners – snug or loose, missing
- Check condition of framing where anchors attach
- Compare to shop drawings and other project documents
- Involve a Specialty Structural Engineer, if needed

Level 2 Analysis – Field Water Infiltration Tests

- Garden Hose Test – not recommended
- Hose Test – AAMA 501.2 (limited use)
- Chamber Test – ASTM E 1105 (best)

AAMA 501.2

Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems

- **Apparatus:** Type B-25, #6.030 brass nozzle with a ½" FPT as manufactured by Monarch Manufacturing Works.
- Use a ¾" water hose with water pressure to produce 30-35 psi.

AAMA 501.2

Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems

- Hold the nozzle at a distance of 1 foot from the most exterior surface of the wall.
- Direct the water spray perpendicular to the face of the test specimen.
- “It is recommended that a gauge be attached to the end of the nozzle to ensure that the specified distance from the joint under test is maintained."

AAMA 501.2

Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems

- Move the nozzle back and forth above approximately five (5) linear feet of the framing and joints, for a period of five (5) minutes. The nozzle is to be maintained in a position perpendicular to the wall.

ASTM E 1105

- Interior or Exterior Air Chamber
- Create Air Pressure Difference
- Spray Water from a Calibrated Spray Rack
- Field Version of Laboratory Test Method
- Simulates the Conditions of a Wind Driven Rain Storm

ASTM E 1105 Air Pressure Chamber

ASTM E 1105 Air Pressure Chamber

<u>OR</u> open a door or window to the exterior

ASTM E 1105 Water Spray Rack

ASTM E 1105 Water Spray Rack

ASTM E 1105 Water Spray Rack

ASTM E 1105 – Observe the Results

Level 3 Assessment

- All of Level 1 and 2 activities, plus
- Theoretical calculations
  - Develop section properties
  - Determine level of wind load resistance
- Structural Analysis
  - Analyze framing members, infill and anchors

Deliverables

- Report
  - Investigation
  - Observations
  - Analysis
  - Recommendations
- Cost Estimate
  - Square Foot Order of Magnitude Estimates
  - Actual Estimates from Contractors
  - Retain Third Party Cost Estimator

Conclusion

- It's Complicated!
- Try to get good intel from building stakeholders
- Look for problems such as water intrusion
- Consider aging
- Disclose the limited scope of your inspection
- If you don't know – get help. Don't guess.

Resources

- GANA - Glass Association of North America
- AAMA - American Architectural Manufacturers Association
- Manufacturer's Literature

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