LESSONS LEARNED FROM CURTAIN WALL FAILURE INVESTIGATIONS

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INTRODUCTION

Curtain walls are a form of exterior cladding that do not support floor or roof loads – they "hang" off of the building structure like a curtain. Although most contemporary exterior wall systems are technically curtain walls, the architecture/engineering/design (A/E/D) community has adopted this term to mean multistory glazed systems. These glazed systems form an integral part of the building enclosure; and as such, they must be designed and constructed to achieve various structural and nonstructural performance requirements, such as the following:

1. Water penetration resistance
2. Air infiltration resistance
3. Structural adequacy (transfer all loads back to building structure)
4. Energy efficiency
5. Aesthetics
6. Durability and maintainability

Other design criteria include thermal movement, condensation, sound attenuation, fire resistance, and blast resistance. These performance requirements apply whether the curtain walls are field-constructed (i.e., stick-built), partially prefabricated (i.e., ladder systems), or fully prefabricated in a factory (i.e., modular or unitized systems). We have observed various problems in meeting these performance requirements with all types of curtain wall systems and during the fabrication, installation, and building occupation stages.

This paper discusses failures and other problems encountered during recent forensic investigations of curtain walls, with the primary focus being on glass and aluminum systems. Failures include air and water leakage, glass breakage, loss of (falling) metal components, and fogging glass. We share these lessons learned with the intention of informing the A/E/D community so that future failures of this nature may be prevented.

THE CASE OF THE MISSING SEALANT

An owner asked us to investigate widespread air and water leakage at his new 14-story office building. The construction of the building exterior had recently been completed, and the office space was approximately 40% occupied. The building included multi-story-height curtain wall "bays" set in large punched openings in exterior walls. Surrounding wall areas consisted mainly of brick veneer cavity wall systems. The stick-built curtain wall system was produced by a large, reputable manufacturer. The system included a combination of pressure glazing (exterior pressure bars at horizontal mullions) and drop-in glazing (fixed exterior bars/stops at vertical mullions) that allow reglazing of vision lites from either the interior or exterior.

We performed a series of water tests, including spray-rack tests followed by hand-nozzle tests for tracing specific leakage paths. Afterward, we disassembled the wall system at multiple bays. We discovered a variety of problems, both with the perimeter flashing of the wall and with the curtain wall itself. With regard to the leakage through the field of the curtain wall, the frame seals were systemically deficient (i.e., missing or otherwise discontinuous), which led to widespread leakage throughout the building. The curtain wall manufacturer's installation instructions, which were part of the submittal package and very clear about the frame seal requirements, had not been followed.

The primary deficiencies of the curtain

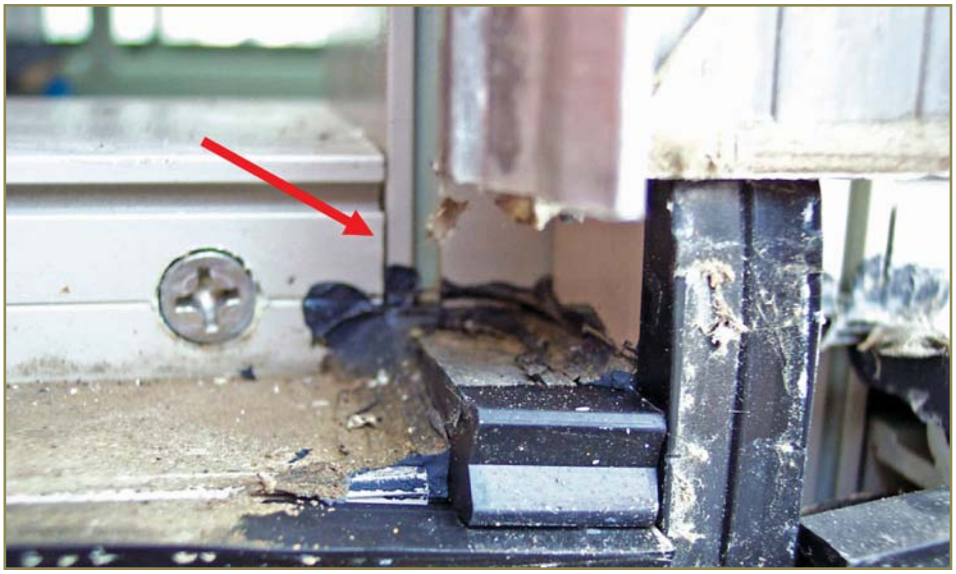

Photo 1 - Unsealed metal-to-metal joint.

wall itself existed at the frame corners (i.e., mullion intersections) and at the splices in the vertical mullions.

Frame corners required application of silicone sealant and foam rubber joint plugs (end dams) to fill and seal the joinery. The intent of these materials is to create a watertight pocket so that any water that enters the glazing pocket area exits harmlessly through the weep holes in the exterior pressure bar. We found missing and deficient end dams and missing and deficient sealant at the metal-to-metal joints where these conditions existed (*Photo 1*). Unsealed joinery located at the low point in the glazing pocket allowed water to travel inward to the building interior just as easily as it traveled outward through the weep holes. Unsealed fastener penetrations at shear blocks at these locations also served as leakage paths.

Splices were in a condition similar to that found in frame corners; negligible weatherproofing provisions were provided, with the exception of an occasional piece of department-store-grade silver duct tape. Splice joints required silicone sealant to be applied to the glazing pocket, which is a wet area. This sealant was not installed. As a result, joints acted as open funnels for any water traveling down the vertical glazing pocket. Splice joints were so poorly constructed that daylight was clearly visible from the interior at these areas when interior finishes and spandrel insulation were removed.

These sources of water leakage also served as avenues for increased air infiltration, though air leakage was a secondary concern for the owner at this point.

The corrective action included repairing 100% of the frame seals at the curtain wall. Unfortunately for all parties involved, this required removal of all of the building's 1,500-plus glass units in order to expose the frame corners that required the repairs. The entire curtain wall was reglazed. Many other repairs were also made, including replacement of perimeter membrane flashing, removal of portions of the surrounding cladding systems to allow the perimeter flashing repairs, and roof repairs.

Lessons Learned

Most curtain wall systems rely on sealant to maintain weathertightness. If sealants are overlooked and poorly installed, a leaky building is inevitable. Deficient frame corner seals can be catastrophic with respect to leakage and are extremely difficult and costly to access for repairs. To ensure that all frame joints are sealed properly during the curtain wall construction/installation phase, follow these recommendations:

1. Obtain the manufacturer's installation instructions regarding frame seals, and enforce them. Require the installers to follow the instructions to the letter. Focus on mullion intersections, splice joints in vertical mullions, and wall perimeter conditions, as well as other areas noted in the instructions.
2. Failing to properly install ¼ oz of silicone sealant can lead to leakage that costs thousands of dollars to access and repair. Take whatever quality control measures are necessary to ensure proper installation of these seals, such as inspections and performance tests by the manufacturer, design team, consultants, and/or third parties.

Photo 2 - Water ponding in curtain wall.

THE CASE OF PROJECTING CURTAIN WALL BAYS

A nine-story mixed-use building enclosed with projecting curtain wall bays, brick veneer, and exterior insulation finishing system (EIFS) was built in the greater Boston area. Shortly after the building was constructed, the owners noticed water leakage at the curtain wall bays, and we were asked to investigate the problems. Water testing with and without applied differential air pressure conducted in accordance with ASTM E2128 and subsequent partial disassembly of the curtain wall showed that the system leaked and did not perform to the specified requirements.

Photo 3 - curtain wall sill flashing not sealed to through-wall flashing.

Photo 4 - Continuous copper and membrane sill, through-wall, and jamb flashing.

Initially, leaks occurred through the curtain wall during water testing at an air pressure differential of 2.1 psf and above (the curtain wall is rated for 10 psf) due to blocked or misplaced weep holes in the pressure bar, missing seals around mullions and joint plugs, and poor drainage (*Photo 2*) from the overapplication of sealant. After running the water for an hour with no applied air pressure difference, we observed higher volume leaks at the perimeter of the curtain wall. Discussions with the owners and the building maintenance personnel revealed that similar high-volume leaks had occurred in the past but only during long rainstorms that lasted for two or more days with and without high winds.

We removed the rowlock brick from the base of the curtain wall and observed that the membrane sill flashing of the curtain wall had been turned up against the brick veneer to form an end dam (*Photo 3*). The through-wall flashing under the curtain wall and brick wall was made from a combination of sheet metal drip edge and self-adhering membrane flashing. The upturned rear leg of the membrane flashing was supported by the backup wall at the brick veneer, but it lacked support under the curtain wall; the transverse seams in the membrane through-wall flashing were open, and the flashing sagged under its own weight.

The greater problem, however, was that the brick wall and curtain wall flashing did not connect or seal to each other (*Photo 3*), and the curtain wall lacked jamb flashing altogether. This discontinuity at the through-wall flashing level allowed water to leak into the building from the wall cavity.

Our review of the design drawings showed vague details, and the specifications were not explicit on flashing integration. Review of construction photographs and discussions with construction personnel showed that the brick veneer was installed before many of the curtain walls. Also, the self-adhering air barrier membrane ran long in many areas, and an 8- to 12-in "flap" was visible in the curtain wall rough openings. The construction manager stated that he told the curtain wall installer to seal the membrane to the jamb of the curtain wall during installation. However, the curtain wall installer either cut the membrane off or folded it into the rough opening.

Repairs involved removing the rowlock brick below the curtain walls, "toothing out" the running bond brick at the sides of the curtain wall, and installing new continuous through-wall and jamb flashing (*Photo 4 and Figure 1*). An alternative cost-saving option was discussed that involved saw-cutting a straight vertical joint through the head joints in the brick veneer; however, this option was ultimately rejected. The repairs were complicated by the lack of working room formed by the inside corners between the brick walls and the curtain wall bays.

Lessons Learned

The inherent geometry of projecting bays creates more corners and intersections between adjacent cladding assemblies than curtain walls built flush within a wall system. Continuity of perimeter flashing is a critical design consideration that is often forgotten. The following are tips to keep in mind:

1. Continuous perimeter flashings that connect to adjacent building components should be fully designed and described in the construction documents. Do not rely on the subcontractors to develop such critical details on their own.
2. Mock-ups of these intersections should be built to vet out potential coordination issues between trades and to confirm trade responsibilities.
3. Consider the risks of leaving "flaps" of air barrier membrane in rough openings that will later seal to curtain wall mullions. Flaps of air barrier membranes are easily damaged if left to hang out of the wall for any length of time. Further, most air barrier membranes are not designed to span unsupported across gaps and are not designed to accommodate differential movement between backup walls and curtain walls; for these conditions, specialty transition flashing membranes should be considered.
4. Provide continuous support for membrane through-wall flashings.

THE CASE OF THE FALLING TRIM COVERS

After maintenance workers began noticing unusual metal components on the ground near a 19-story building in the Northeast U.S., we were asked to investigate the cause. Metal trim covers were falling off the building, presenting a danger to people and property below. The curtain wall included various snap cover sizes and profiles ranging from 3/8-in low-profile covers to projecting covers more than 2 in deep.

We performed a 100% survey of the façade, which consists almost exclusively of unitized curtain wall panels. We found a handful of areas where covers were missing, and we found dozens of areas where covers were slightly disengaged. The disengagement was often visible via a small (1/16-in to 1/8-in) joint between the inside edge of the snap cover and the exterior glazing gasket at the pressure bar (*Photo 5*). This open joint was not present at properly engaged covers.

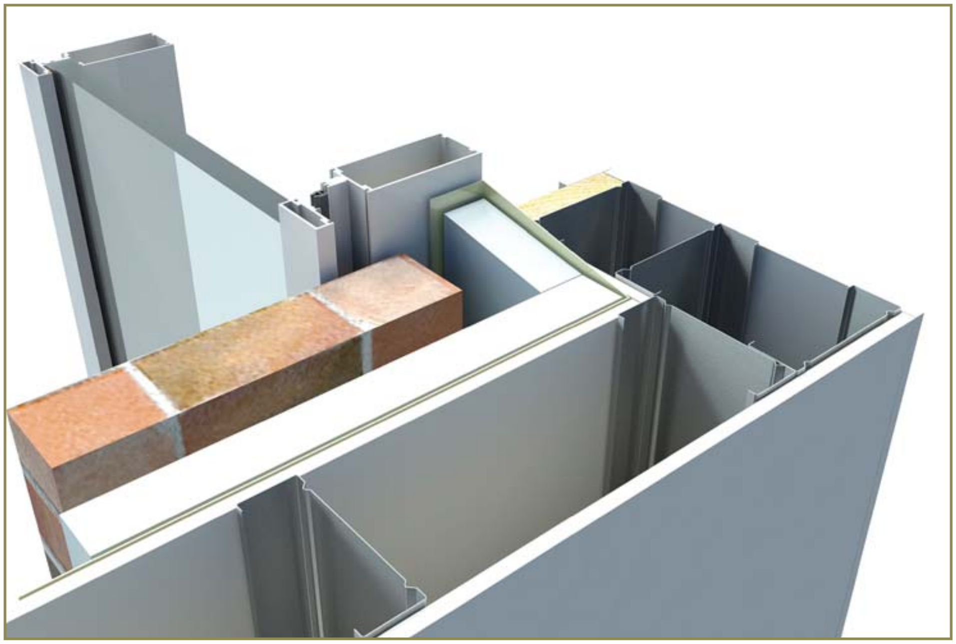

Figure 1

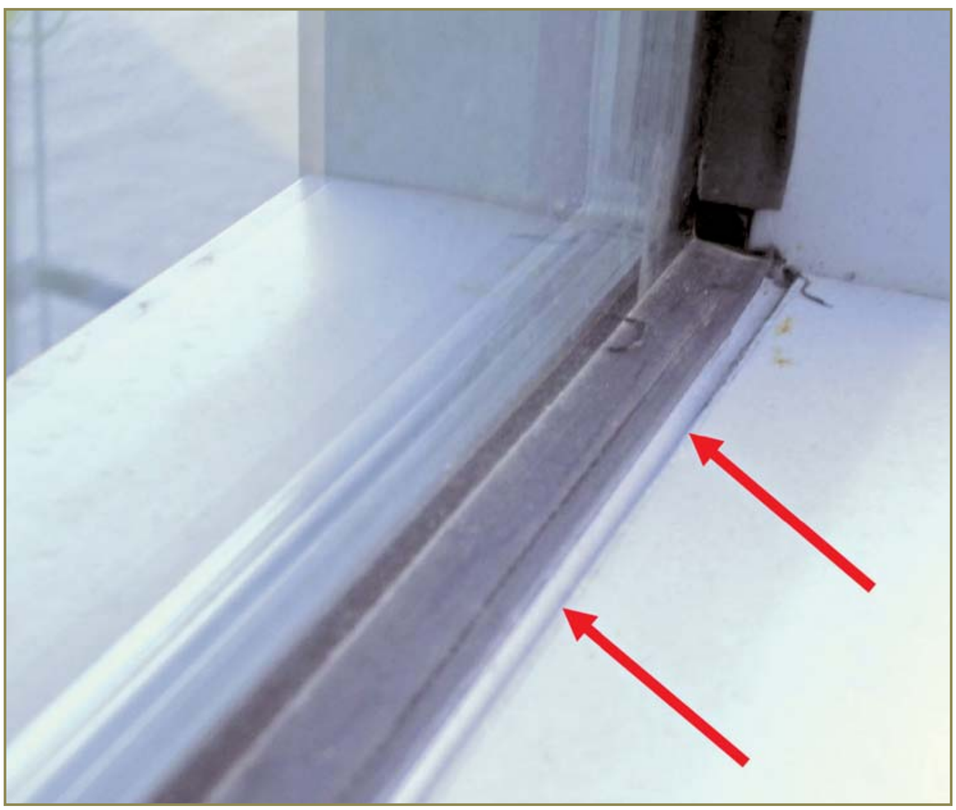

Photo 5 - Space between glazing gasket and trim cover.

Photo 6 - Trim cover removed from curtain wall by hand with minimal effort.

Photo 7 - Bent corner of pressure bar.

We reviewed these partially engaged covers up close and performed an ad hoc "yank" test. Many covers detached from the wall with little effort (*Photo 6*). Some of the disengaging covers did not immediately release due to the presence of a few daubs of silicone sealant that temporarily held the cover in place. However, after applying light pressure, the covers readily came loose.

During our survey, we noted that the corners of the pressure bars below the disengaged covers were bent upward, preventing proper snap engagement of the covers (*Photo 7*). We also noted physical damage to dozens of covers, such as dents, scratches, and other evidence of abuse. The root cause of the pressure bar cover damage was not conclusively determined. We suspect that it was due to abuse during attachment onto the building. Other theories with merit include poor cutting operations in the factory and bending of covers when they were removed for other reasons, such as to allow reglazing of a failed glass unit.

One additional factor in the falling cover problem included the use of a suspended scaffold (swing-stage) window washing and maintenance rig that bumped the deeper horizontal covers on its way up and down the building. The house rig included clips designed to engage a vertical rail mounted to occasional vertical curtain wall mullions in order to help secure the rig to the wall. Unfortunately, the projecting wheels on the rig were not considered in the staging and curtain wall design. As such, the rail system was ultimately abandoned. On a related note, window washers not using a scaffold have been seen standing on the horizontal covers.

Perhaps the most disheartening factor for the owner was that the bent pressure bar corners could have been fixed quickly and easily during the original installation by simply bending the bent covers back into place with a pair of common pliers (*Photo 8*). Unfortunately, the original construction process included an aggressive schedule for curtain wall erection, and this quick fix was not implemented. Consequently, a 100% survey and widespread repair campaign were implemented within five years of construction of the building. We added fasteners to all snap covers as part of the repair process, just to provide an additional safety factor and more comfort for the owner.

Lessons Learned

While the primary function of snap covers is visual, falling metal is a serious safety hazard. Do not completely disregard the design of exterior snap covers as might be commonly done for interior trim. When using snap covers, keep in mind the following:

1. Snap engagement alone of unusually deep or otherwise precariously projecting metal components cannot be relied upon for permanent attachment.
2. Be mindful of haphazard erection techniques and the risk of damage to weakly secured components. Be particularly careful with unitized wall assemblies due to hoisting/

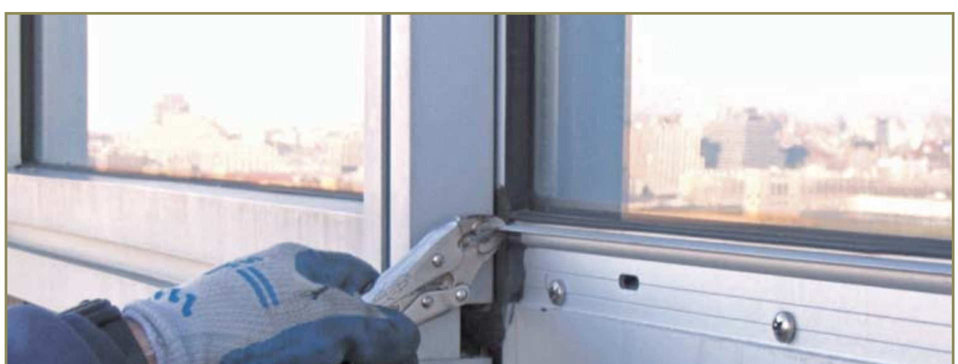

Photo 8 - Fixing pressure bar with pliers.

craning erection techniques.

3. Consider maintenance and related access needs of the wall systems when designing exterior covers, sunshades, and other projecting elements.

THE CASE OF THE WINDOW FILM

We investigated the cause of insulated glass (IG) units that were breaking at a recently renovated office building (*Photo 9*). The window installer removed several IG units and observed that glass-to-metal contact was the cause of some of the breaks. However, the installer could not provide an explanation for all of the cracks. We visited the site and found two crack patterns in the glass. About three quarters of the cracked IG units had cracks that ran perpendicular to the edge and surface of the glass (indicative of thermally driven breaks). The remaining one quarter of the IG units had cracks that did not run perpendicular to the edge. All of the IG units had a postapplied tint film on the interior surface (for increased occupant comfort) and vertical blinds in the offices. Cracks were occurring on the south and east elevations only and in IG units with and without postapplied film.

Our review of the original shop drawings and specifications showed the IG units had a ¼-in thick exterior lite, a ½-in wide air space, and a ¼-in-thick laminated glass inner lite with a 0.030-in-thick interlayer (*Figure 2*). The glass surfaces on *Figure 2* are labeled #1 through #6. All glass was to be annealed (i.e., not heat-strengthened or tempered). Setting blocks were shown in the sill of the glazing pocket; antiwalk blocks were not shown. Antiwalk blocks prevent the glass from moving laterally, or walking in the frame and bearing against hard metal surfaces, reducing the glazing/gasket contact area. Glass is specified according to probability of breakage because of its susceptibility to the stress-concentrating effect of flaws and the statistical nature of flaw severity and distribution. The specifications required that the probability of failure of the IG units, upon first application of the design wind, would not exceed 8 lites per 1000. The submittals showed that two different tinted films were used.

We performed a thermal analysis on the IG units, film included, based on ASTM E2431, *Standard Practice for Determining the Resistance of Single Glazed Annealed Architectural Flat Glass to Thermal Loadings*. This analysis assesses the probable edge stress in the glass as a result of the temperature differential between the exposed central regions of the glass and the concealed edge (*Figure 2*). Current industry standards for determining thermal edge stresses in annealed glass apply only to monolithic glass. Other analyses were required to assess the more complex IG unit with applied tint. (A standard for evaluating thermal stress in IG units is currently under development by ASTM.)

First, we calculated the solar load for the IG units using a glass/optics computer program. This step took into account the solar transmittance and absorption of the different components: glass, air space, interlayer, film). We essentially built mono-

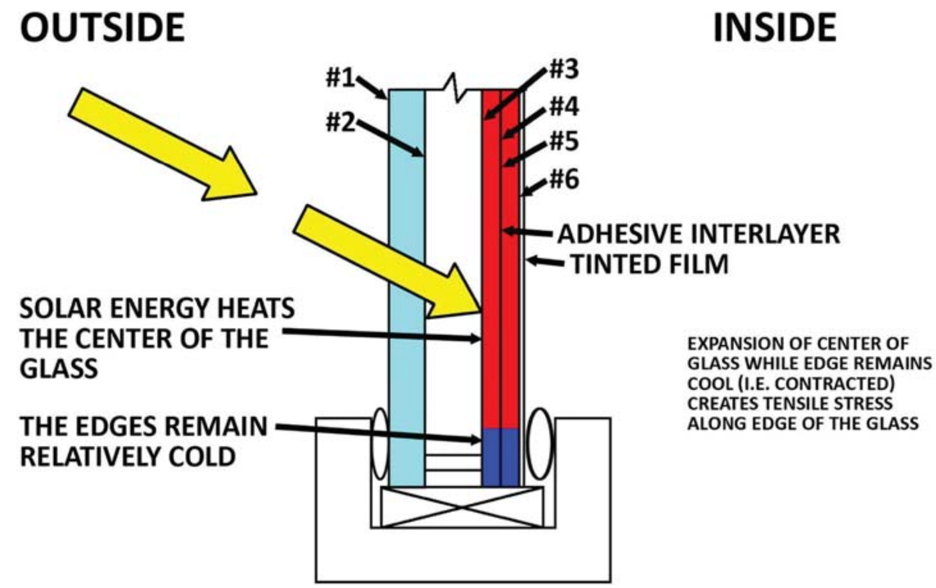

Figure 2

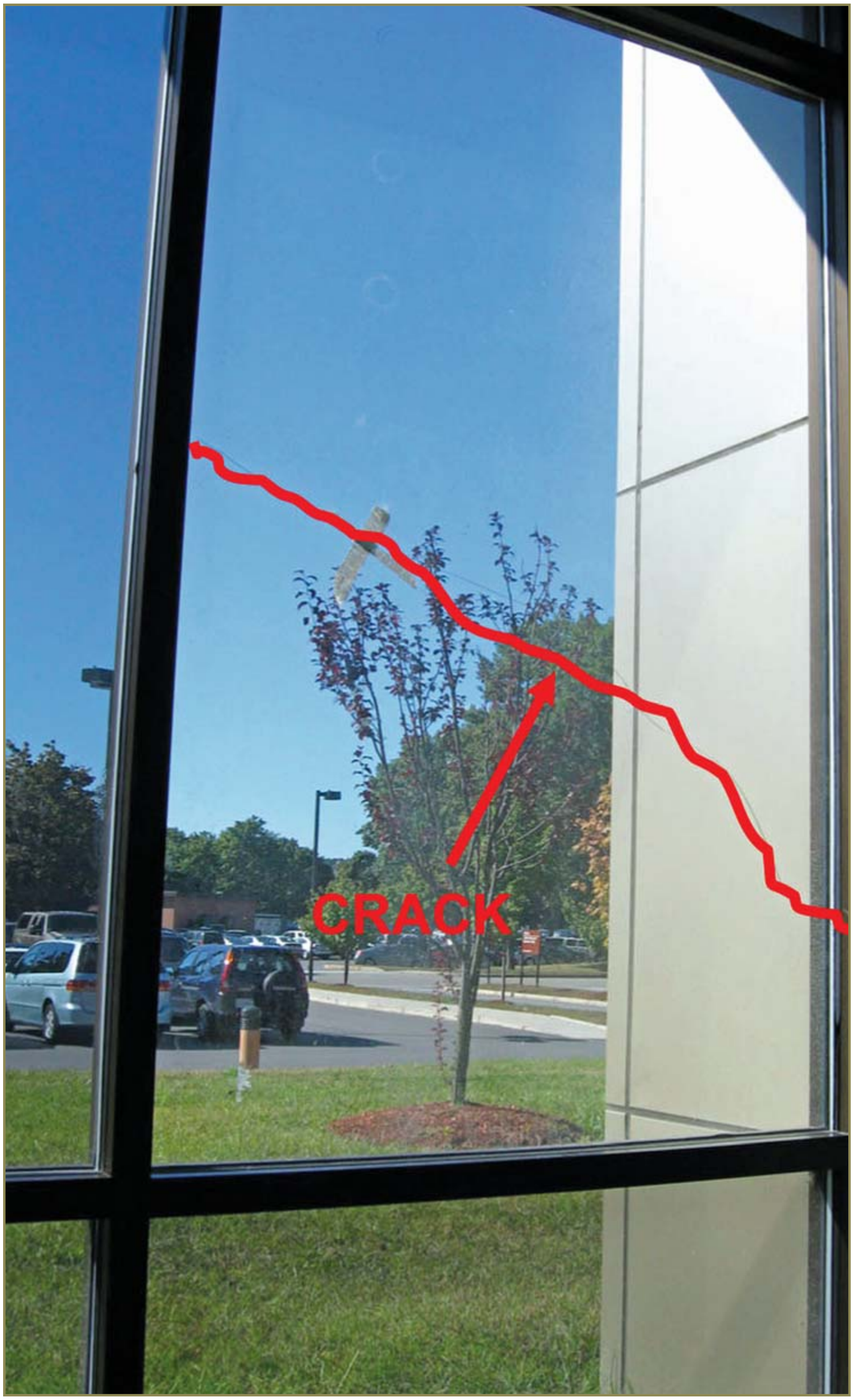

Photo 9 - Crack in IG unit.

lithic glass models with similar optical properties to the specified IG units.

Next, we calculated the allowable thermal stress for various-sized IG units on the building, based on the allowable breakage rates set by the specifications. The predicted in-service thermal stresses were acceptable on the north elevation, but they were excessive on the west, east, and south elevations. Our analysis showed that a south-facing unit with an angular shadow pattern would reach the highest stress. The tinted film causes excessive thermal loading in the glass.

Our analysis showed that a stronger glass, such as heat-strengthened glass, could handle the high thermal stresses. The owner replaced the cracked IG units with heat-strengthened glass of the same thickness and size. Antiwalk blocks were installed during reglazing to prevent the glass from moving laterally and contacting metal.

Lessons Learned

For projects requiring use of IG units and an applied film, remember the following:

1. Follow industry guidelines for IG unit construction (e.g., the Glass Association of North America) and installation guidelines for applied films (e.g., technical documents by glass manufacturers) when incorporating glass film in a project.
2. If specifying tinted films, reflective blinds, insulating drapes, or other components that could increase the center-to-edge temperature difference and thermal stress in the glass, consider using heat-strengthened glass. The stress analysis to determine the appropriate type of glass should be based on ASTM E2431 and modified as described above. If a more precise stress assessment is required or more complex glass configurations and loadings are encountered, the analysis should be based on finite element modeling.
3. Review curtain wall shop drawings and require antiwalk blocks at all vertical glass edges.

THE CASE OF THE EXPLODING GLASS

We witnessed this glass breakage firsthand during performance testing of a large mock-up assembly at a testing laboratory (*Photo 10*). The failure occurred during a 150% ASTM E330 overload test. The test applied 150% of design wind load for façades. The failure occurred during a second, unspecified overload test that the contractor elected to complete. We noted no visible damage during the first overload test.

The curtain wall system that failed includes intermittent aluminum clips that engage a channel at the perimeter of the IG unit. Butt seals constructed of weatherproofing sealant, similar to those installed at structural silicone-glazed (SSG) curtain wall system joints, were installed at joints between IG units. The custom-designed outside corner condition is "mullionless" and does not include clips. Vertical corner framing, which carries a portion of the dead load of the corner area, consists only of a 1.5-in by 1.5-in aluminum tube. The tube is adhered to the glass edges with structural silicone sealant.

We reviewed the remnants of the glass and glazing materials at the opening of the failed unit (*Photo 11*). The spacer bar along the noncorner jamb was fully disengaged from the clips, and the spacer bar was bent at various clip locations. We noted damage to the interior pane of glass at more than one clip location, with the most severe damage located approximately 12 inches up from the sill corner. The structural silicone and low-profile aluminum tube at the corner were undamaged.

We also reviewed a video of the glass breakage frame-by-frame after returning to the office. At the time that this article was written, analyses being performed by the curtain wall manufacturer, insulating glass manufacturer, and the structural engineer who designed the curtain wall framing are ongoing. From the video images, it is clear that the glass disengaged from the mechanical clips along the jamb prior to fracturing. The still-frame images show the jamb of the glass unit free of the mullion prior to breakage. It is also clear that the center of the glass unit deflected outward significantly and that the corner tube also deflected slightly. The deflection of the corner tube, combined with the movement of the glass edge due to center-of-glass deflection, resulted in full loss of engagement at the clips. The edge of the interior pane of glass

Photo 10 - Glass break.

Photo 11 - Curtain wall after 150% design load test.

contacted the edge of one of the aluminum clips as the glass unit exited the opening, resulting in breakage.

When designing the curtain wall system, the structural engineer originally considered only the aluminum framing in his or her analysis; no consideration was given to glass deflection. The insulating glass manufacturer was expected to confirm the strength of the glass units, which is common. With regard to the corner tube, the structural engineer considered it as a hanger tube that supported dead load only. The structural engineer knew the corner tube was not very stiff and therefore simply assumed the wind load would find its way to the horizontal mullions, which were designed to resist that load. The structural engineer and the glass manufacturer operated independently, allowing oversight of this interaction issue.

The project team is currently pursuing options for remedying this issue and moving forward with the integrated design and construction phases.

Lessons Learned

The root causes of glass breakage can often be traced back to glass-to-metal contact, often due to metal objects being slightly closer to the glass edge than expected. Sometimes structural interaction between various elements of a custom system can lead to unforeseen movements and related problems. Glass is a fragile material, and glazing pockets are tiny spaces. Slight deviations in the expected dimensions and deflections can lead to glass-to-metal contact and breakage. Careful review and analysis is needed, both for structural performance and for field-installed items that involve metal components in close proximity to the glass. Keep these points in mind for future projects:

1. Consider all metal objects in close proximity to glass, and evaluate the possibility for migration and dimensional variations. Provide cushion for the glass on all sides to allow the glass units to "float" within the opening.
2. Perform a full structural analysis of all typical and unusual conditions, including consideration of all deflections. Consider the combined effects of deflections of multiple objects simultaneously. Do not analyze framing separately from glass, even if this is convenient contractually, because the two systems do interact.
3. Consider all tolerances, including combined effects of fabrication, installation, structural, and all other related tolerances.

THE CASE OF THE SPOTTED GLASS

We investigated large failed insulating glass units at a waterfront curtain wall with an unusual and complex geometry. The wall is both sloped (tilted backward/inward) and curved (concave). Building occupants and maintenance staff started noticing visual obstructions within the air space of the glass units, including small brown spots caused by deterioration of the metallic low-emissivity (low-e) coating. The expensive, customized wall system was in place for less than five years before the occupants began complaining about the glass failures.

We reviewed the curtain wall system as well as the insulating glass units themselves after deglazing. We found various problems that were contributing to the failures, though the primary cause was defective glass units. The curtain wall included weep holes in exterior pressure bars and positive slope toward the weeps to overcome the backward tilt of the wall. However, we observed a significant amount of debris in the glazing pocket that absorbed water and slowed drainage. It appeared that most of the debris was built into the wall during the original construction phase. Glazing pockets were not cleaned out prior to installation of glass. Much of the water that entered the glazing pocket drained harmlessly out the weep holes, but some collected in these horizontals due to this debris. This collected water condition increased the relative humidity (RH) of the glazing pocket space. Also, the insulating glass unit edges likely sat in water on occasion. Both issues increased the risk of premature glass seal failure.

In addition to the debris issue, the insulating glass hermetic seals were faulty at failed units. We deglazed several units and inspected them up close at a curtain wall subcontractor's shop. Upon close inspection, we noticed an open "blister" in the silicone secondary seal at one corner (*Photo*

Photo 12 - Open blister in silicone secondary seal at the corner of an IG unit.

12). The blister aligned with an unsealed keyed corner of the spacer bar. The blister formed prior to curing of the sealant. This blister may have resulted from pressure being applied to the IG unit before the secondary sealant cured. Another possible cause is that there may have been a mixing or manufacturing problem with the sealant material that caused the air bubble to form. Air escaped through a discontinuity in the spacer bar and primary seal at the keyed corner and exited through the uncured silicone sealant, which resulted in the blister. Inspection of other failed units revealed similar blisters.

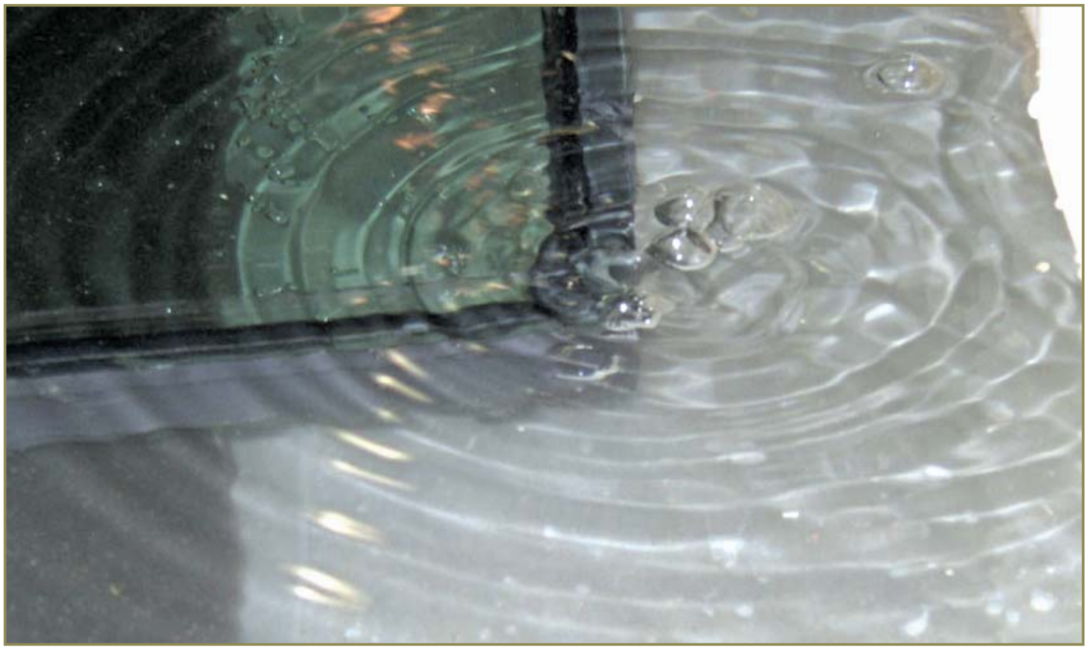

Photo 13 - Air bubbling from IG unit.

To confirm that the blistered sealant at the keyed corner was the root of the problem, we placed failed units in a water bath and applied slight pressure to the units. We witnessed air bubbles exiting the blistered corners, which confirmed that there were breaches in the continuity of the hermetic seals (*Photo 13*). Small amounts of moisture vapor reaching the sealed air space were reacting with the metallic low-e coating in the air space and causing the formation of the brown spots.

Insulating glass units cannot readily be dried out once the hermetic seal is breached and the interstitial space is saturated; therefore, we recommended replacement of all affected units. We also suggested cleaning debris from all glazing pockets to encourage prompt drainage.

Lessons Learned

Hermetic seal failures may be the result of manufacturing defects, design, and construction flaws that unnecessarily expose the seals to water or, more often, a combination of these factors. Carefully specify, check, and enforce high-quality hermetic seal conditions, and design and install draining curtain wall systems that quickly remove water from the glazing pocket. To do so, keep in mind the following:

1. Specify durable, time-tested insulating glass unit spacer and hermetic seal details, such as those given below.
   - A. Require spacer bars with bent, soldered, or welded corners. Seal [illegible]pe the spacer bar joints (do not simply dry fit joints with a splice key). If keyed corners cannot be avoided, inject the key condition with butyl sealant.
   - B. Require continuous primary and secondary seals. Require continuity of both seals at all corners and joints.
   - C. Rigorously inspect insulating glass units that arrive at the site and reject any units with seal defects. Increase frequency of inspections if even one bad unit is found. Consider visiting the insulating glass manufacturer's shop to review its operations. For insulating glass units set in unitized frames, visit the assembly plant prior to glazing the frames.
2. Select curtain wall systems that promptly drain all water to the exterior.
   - A. Avoid surface-sealed systems that provide no drainage provisions. Wet seals help limit water entry into the system, but do not rely on them alone to provide waterproofing protection.
   - B. Provide weep holes at the low point of flat horizontal surfaces that may collect water. Slope sill conditions toward weep holes whenever possible for prompt drainage.
   - C. Avoid systems that drain down the vertical mullions; instead, drain water directly out weep holes at the sill of every glass lite. If water is drained down the verticals, it may contact the edges of IG units or pond on top of IG units, increasing the risk of premature failure.
   - D. Be careful not to obstruct glazing pockets with debris, excess frame sealant, or glazing accessories, as this can slow or prevent drainage.

CONCLUSIONS

Curtain walls are often effective and durable exterior wall assemblies when consideration is given to good design and installation practices and problems experienced on past projects. Below, we summarize the fundamental lessons taught by the experiences described herein.

1. Curtain walls are highly dependent on sealant. Follow the manufacturer's installation instructions regarding frame seals, and implement a quality assurance program.
2. Provide continuity of flashing materials at the perimeter of the wall system.
3. Use mock-ups to confirm sequencing, coordination, and workmanship.
4. Fully analyze and test unique designs prior to constructing them on a building.
5. Beware of thermal stresses in

annealed glass.

6. Work through potential problems early in the project.

Due diligence during the design, preconstruction, testing, and installation phases is warranted to identify and avoid potential problems. Preventable problems range from the relatively simple (making sure that sealant is installed correctly) to the more complex (finite element modeling of complex glass configurations).

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USGBC Sued For Deceptive Claims

A class action lawsuit has been filed in federal court against the U.S. Green Building Council (USGBC) and its founders. Filed on behalf of mechanical systems designer Henry Gifford, owner of Gifford Fuel Saving, the suit argues that USGBC is fraudulently misleading consumers and misrepresenting energy performance of buildings certified under its LEED® rating systems, and that LEED® is harming the environment by leading consumers away from using proven energy-saving strategies.

To support this allegation, Gifford cites a 2008 study from New Buildings Institute (NBI) and USGBC that is, to date, the most comprehensive look at the actual energy performance of buildings certified under LEED® for New Construction and Major Renovations (LEED-NC®). While the NBI study makes the case that LEED® buildings are, on average, 25–30 percent more efficient than the national average, Gifford published his own analysis in 2008 concluding that LEED® buildings are, on average, 29% less efficient. A subsequent analysis of the NBI data by National Research Council Canada supported NBI's findings, if not its methods.

— GreenBuilding.com

RDU Terminal Uses Lenticular Wood-Truss Structure

The latest addition to the Raleigh-Durham International Airport (RDU) opened on January 24 sporting a unique look that uses laminated Douglas-fir trusses. The project's designer, Denver-based Fentress Architects, claims RDU is the first major airport in the world to use a "lenticular wood-truss structure" to support a roof. In all, 80 trusses span the entire length of the terminal and concourse at 30-ft intervals. The trusses are 90 ft long and weigh 34 tons each. The latest phase of the terminal's construction adds 920,000 sq ft to the 550,000 sq ft that opened in 2008, at a total cost of $570 million. Parsons Transportation Group, Pasadena, CA, was the project manager; Archer Western, St. Louis, MO, was the general contractor.

— ENR