Key Points in Curtain Wall Firestopping

March 27, Fouad Hajj
1. **What is Curtain Wall Firestopping?**
2. CW Standards
3. What does the code require.
4. CW Testing
5. Failure Points and implications
6. U.L. Systems
7. Installation Issues
8. Inspections
The slot between the slab and the Curtain Wall must be PROPERLY firestopped....
If the Curtain Wall firestopping is not properly installed, in case of fire, the result can be catastrophic...

Windsor Tower, Madrid 2005
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Therefore, it’s crucial that CW designs be tested to the correct standards.

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Curtain Wall testing is done by using the Intermediate Scale Multi-storey Apparatus (ISMA)

Pre-Burn
Exterior Burner Lit

Time: 0:05
Melting of Mullions & Transoms

Time: 0:45
Burner off at 2 Hours

Time: 2:00
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Post Test Analysis indicates the failure points that need special protection.

Close up Detail of Mullion and Transom Damage
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STI has invested heavily in Curtain Wall testing:

- UL is the premier fire testing lab in the US
- STI tests mostly at UL
- STI designed and tested the first C.W. System with vision glass
- STI has more UL C.W. tests than all other competitors combined! (93 out of 123)*
- As a result, STI has privileged working relationships with major C.W. designers/engineers around the world

Understanding the UL Directory Numbering System

1. Floor Assembly - Min 6-1/2 in. (14 mm) thick reinforced lightweight or normal weight (190-195 psf or 1900-2400 kg/m3) structural concrete. Perimeter of floor assembly to be provided with min 3 in. by 1/4 in. (7.6 by 6.4 mm) thick cast-in-place structural steel angles for wall attachment of sillion mounting clips (item 2A).

2. Curtain Wall Assembly - The curtain wall assembly shall incorporate the following construction features:
   A. Mullion Mounting Clips - Min 4 in. (102 mm) long angles with one nominal 4 in. (102 mm) leg attached to edge of four assembly and the other leg approximately 4 in. (102 mm) longer than distance to nearest face of mullion. Clips to be formed of min 1/4 in. (6 mm) thick steel. Clips welded to steel angle at edge of assembly (item 1) on each side of vertical mullion (item 20) at each floor level. Each clip to be provided with elongated holes to accommodate desired amount of movement. Top edge of each clip to be recessed min. 1/2 in. (13 mm) below top surface of floor.
   B. Framing - The rectangular tubing mullions (vertical members) and transoms (horizontal members) shall be min 2-1/2 in. (64 mm) wide x 1-7/8 in. (48 mm) deep and shall be fabricated from min 0.095 in. (2.3 mm) thick aluminum. Mullions spaced max 60 in. (152 cm) OC and secured to mullion mounting clips (item 2A) at each floor level with two 3/8-16 by 4 in. (102 mm) long hex head steel bolts in conjunction with Steel nuts and washers. Interior face of mullions to be max 8 in. (204 mm) from edge of floor assembly. Transoms to be spaced min 36 in. (91.4 cm) OC. The minimum height from the top of the floor to the bottom of the vision panel sill is 6 in. (152 mm).
   C. Spandrel Panel - The spandrel panel shall consist of one of the following types:
      a. Glass Panels - Nom 1/4 in. (6 mm) thick opaque heat-strengthened glass. Each panel secured in position with aluminum pressure plates in conjunction with gaskets and steel screws.
      b. Aluminum Panels - Nom 1/8 in. (3 mm) thick aluminum panels with 1/4 in. (6 mm) thick edges. Each panel secured in position with aluminum pressure plates in conjunction with gaskets and steel screws.
      c. Stone Panels - Nom 1-3/16 in. (46 mm) thick polished granite spandrel panels with 1 in. (25 mm) thick gauged edges. Each panel secured in position with aluminum pressure plates in conjunction with gaskets and steel screws.
   D. Vision Panels - Nom 1/4 in. (6 mm) thick transparent heat-strengthened glass or nom 1/3 in. (8 mm) thick insulated glass units with two layers of nom 1/4 in. (6 mm) thick transparent heat strengthened glass separated by a 1/2 in. (13 mm) air space. Each panel secured in position with aluminum pressure plates in conjunction with glass gaskets and steel screws.

F. Spandrel Panel Perimeter Angles - Nom 1-1/2 by 1-1/2 in. (38 by 38 mm) No. 22 gauge (0.031 in. or 0.79 mm thick) galvanized steel angles installed around entire perimeter of each spandrel panel. Angles recessed from interior face of framing as necessary to accommodate thickness of curtain wall insulation (item 2G). Angles cut to be discontinuous at mullion mounting clips (item 2A). Angles screwed to mullions and transoms along sides and top of frame. Angles to be min 1 in. (25 mm) long self-drilling, self-tapping steel screws spaced max 12 in. (305 mm) OC. Angle along bottom of each spandrel panel to be screwed to mullion to prevent any movement. Angle legs forming the stem of the tee shall be secured together using No. 8 by 1-1/2 in. (38 mm) long self-drilling, self-tapping steel screws spaced max 8 in. (203 mm) OC. The tee shall be installed with a clearance of 1/8 in. by 1/4 in. (3.2 by 6.4 mm) at each end and shall be screwed to the spandrel panel perimeter angles (item 2E) with No. 10 by 3/4 in. (19 mm) long self-drilling, self-tapping steel screws, with steel washers, through two predrilled 1/4 in. (6 mm) diameter holes at each end. One spandrel tee shall be located on the stem at an elevation 1/2 in. (13 mm) below the top plane of the floor at each level.

G. Curtain Wall Insulation - Min 2 in. (51 mm) thick mineral wool batt insulation faced on one side with aluminum foil/silica vapor retarder, supplied in min 36 in. (914 mm) wide rolls. Insulation rolls to be installed with no vertical seams. Insulation panels tightly fitted between vertical mullions and between the stem of the spandrel tee (item 2E) and the transom, flush with the interior surface of framing. Insulation panels secured to spandrel panel perimeter angles and to each spandrel tee with cap head weld pins (item 2G) or 4-1/2 in. (114 mm) long steel screws with min 1-1/2 in. (38 mm) diameter galval steel clinch shields spaced max 12 in. (305 mm) OC. The horizontal seam between insulation panels shall be located 2 in. (51 mm) below the top plane of the floor at each level.

H. Framing Covers - Curtail Wall Insulation - Min 8 in. (204 mm) wide strips cut from the same min 2 in. (51 mm) thick mineral wool batt insulation used for the curtain wall insulation (item 2G). Framing covers to be centered over mullions and secured to the spandrel panel perimeter angles with cup head weld pins (item 2G) or 4-1/2 in. (114 mm) long steel screws with min 1-1/2 in. (38 mm) diameter galval steel clinch shields spaced max 12 in. (305 mm) OC. Where more than one spandrel panel (item 2C) occurs between vertically separated vision panels, the horizontal transom between spandrel panels shall also be covered with an 8 in. (204 mm) wide framing cover in the same manner as on the vertical mullions. Framing covers on mullions to attach the mineral wool batt safety material (item 3A) above and below floor.

I. Welded Pins - In lieu of steel screws, No. 12 gauge (2 mm diam) galval steel weld pins with min 3-1/2 in. (89 mm) diam galval steel cup head. Cup head weld pins provided in two lengths. One length to be equal to thickness of curtain wall insulation (item 2G) and second length to be equal to thickness of curtain wall insulation plus thickness of framing cover (item 2H). Cup head weld pins inserted through curtain wall insulation and insulation covers and welded to spandrel panel perimeter angles max 12 in. (305 mm) OC.

J. Light Gauge Framing - Spiral Anchor - (Not Shown) - An alternate to the weld pins (item 2G), galval steel wire spirals anchored in the vision panels (item 2G) or the curtain wall insulation (item 2G) on each side of the mullion. Nominal length of spiral anchors to be equal to thickness of curtain wall insulation plus thickness of framing cover. Spiral anchors driven through insulation covers and into curtain wall insulation and spaced max 12 in. (305 mm) OC.

3. SaFing System - Max separation between edge of floor assembly and face of framing members (at time of installation) is 8 in. (204 mm). The saFing system is designed to accommodate vertical shear movement up to a max of 5 percent of its installed width. The saFing system shall incorporate the following construction features:
   A. Foreiling Material - Nom 4 pic (94 kg/m3) density mineral wool batt insulation. Batt sections out a min 4 in. (102 mm) wide and stacked to a thickness which is min 25 percent greater than the width of linear gap between the curtain wall insulation and the edge of the concrete floor slab. The stacked foreiling material is compressed 20 percent in the thickness direction and inserted edge-first into the linear gap such that its top surface is flush with the top surface of the floor assembly. A max of one tightly-fitted seam to be permitted between mullions. Additons pieces of foreiling material to be friction-fit into spaces between mullion mounting clips at each mullion location.
   B. FilI, Void or Cavity Material - Min 1/8 in. (3 mm) wet thickness (min 11/16 in. or 1.6 mm dry thickness) of fibr material spray-applied over top of foreiling material and tapping min 1/2 in. (13 mm) onto the top surface of the floor and onto the curtain wall insulation and framing covers.

Specified Technologies Inc. - Spec-Ead AS2000 Esposito Spray or Spec-Ead Fast Track Spray

*Beating the UL Classification Mark.
CW-D-2042

First Two Alpha Characters “CW”

Identifies the gap between a fire rated floor and a non rated exterior curtain wall

Third Alpha Character is “S” or “D”

“S” Static Joints

“D” Dynamic Joints
CW-D-2042

Number Range = Max Clearance Distance Between Curtain Wall and Perimeter of Floor

0000-0999 = Less Than or Equal to 2”

1000-1999 = Greater than 2” - Less than = to 6”

2000-2999 = Greater than 6” - Less than = to 12”

CW-D-2042

Last Three Numeric Components = Test Number in the Series

Designates 042 as the 42nd test in the 2000-2999 PFCS series
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Aluminum Tubular Mullion

1. Perimeter Angle
2. Stiff-Back Angle
3. Foil Faced Mineral Wool 8PCF
4. Slot Treatment:
   a. Mineral Wool (4 PCF) compressed and fitted tight in safing slot
   b. AS-205 Spray over MW Safing
5. Mullion Covers: Mineral Wool 8PCF

Panel (aluminum, or stone)

and Vision Glass

Concrete Slab
Steel Back-Pan Spandrel Panel
CW-S-0002

ONLY BACK-PAN TESTED SYSTEM.

PATENDED DESIGN!
January 20, 2011

Specified Technologies Inc.
Mr. James Stahl Jr.
200 Evans Way, Suite 2
Somerville, NJ 08876

Our Reference: File R14288

Subject: Engineering Studies for Perimeter Fire-Containment Systems

Dear Mr. Stahl:

This is to confirm our conversations regarding the Subject. It has come to our attention that engineering judgments for perimeter fire-containment systems incorporating steel back pans are being issued despite having no tested or listed designs for curtain walls with steel back pans to reference as the basis for such judgments.

Based on our previous testing experience, we have found that the steel back pan condition is a critical configuration from a fire test perspective. Testing conducted in accordance with ASTM E2307, Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus, has demonstrated that the thermal expansion of the steel pan can cause it to distort and deflect, stressing the perimeter fire containment system under fire conditions and in some cases causing the perimeter containment system to become dislodged. The fill material applied over the safing system in the perimeter fire-containment system can also be exposed to a significant amount of heat from the steel back pan and could cause ignition of sealants or coatings during the course of fire exposure.

UL has several published designs for steel back pan curtain wall conditions listed in the Fire Resistance Directory. Such published designs diminish the need for engineering judgments for this common yet critical condition.

Should you need any further assistance, please do not hesitate to contact us.

Very truly yours,

STEVEN J. HOFFMAN
Staff Engineer
Fire Protection Division

Reviewed by:

C. J. JOHNSON
Lead Engineering Associate
Fire Protection Division
Reverse Back-Pan (Shadow Box)  
Spandrel Panel CW-D-1009

- Perimeter Angles
- Stiff-Back Angle
- Shadow Box
In rated construction, all floors are rated.

The safing slot must be sealed in a manner that extends this rating to the exterior wall surface.
Do not adequately protect the safing slot!

Mineral Wool Installation

Safing is cut slightly oversized and jam fit into the opening foil side up with the grain parallel to the floor.

Z shaped steel safing clips are used to impale the safing and suspend it into the opening.
...Do not adequately protect the safing slot!

Sealant Installation

Two caulk beads are applied to seal the edges of the foil facing to the adjacent surfaces.
Traditional Designs

Do not adequately protect the safing slot!

In a Fire...
The insulation is oriented improperly... It lacks resilience and will not rebound.

As it burns, the edges shrink inward creating gaps.
Take advantage of Mineral Wool’s natural resilience to help keep the slot closed during a fire!

Mineral wool safing is oriented with its grain running vertically.
Use Proper Orientation and Compression

Providing maximum compression and extension and a tight fit against the spandrel insulation without the need for safing clips!

Assuring a tighter smoke, gas, and fire seal!
Use Proper Orientation and Compression

It is simple and easy to do!
Benefits of Pro-Actively Designing the Safing Slot

- Maintains compartmentation
- Prevents the migration of smoke through to floors above.
- Buys time for occupants to escape.
- Provides additional protection in the event of a sprinkler failure.
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Step 1: Verify Documents and submitted Drawings reference Legitimate Perimeter Fire Barrier Systems such as UL. CW-S or CW-D

Step 2: Verify the Rating of the System is Greater than or equal to the rating of the floor

Step 3: Verify Firestop material to be used and listed for use in Perimeter Fire Barrier Systems.

Step 4: Verify Documents reference systems that have been tested with windows or vision glass if the building has glazing close to the safing area.

Step 5: Verify Stiff steel reinforcement member, if required, has been placed behind exposed curtain wall panel insulation.
Step 6: verify Insulation and brand used is listed within the tested system. Rock wool is the typical insulation of choice.

2080 °F (5 hours)
Mineral wool still intact

Fiberglass Insulation Fails (6 Minutes) at 1050 °F and IS Not To Be Used In a Fire Containment Assembly
Step 7: Verify Insulation panels are securely fastened with mechanical fasteners per the system, instead of just friction-fitted in place.

Step 8: Verify the exposed mullions, if required by the system are covered with the proper insulating barrier securely fastened with mechanical fasteners per the system design.

Step 9: Verify Sealant is applied to the proper depth

Step 10: Verify the Parameters indicated in the system are the same as those installed in the field.
The IFC has put out a “Firestopping Inspection Manual” to help field inspectors.
In Conclusion

Thanks

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