Curtain Wall Fire Protection Systems
Fire Statistics

Why must we contain Smoke, Toxic Gases and Fire?

3/4 of all fire deaths are caused by smoke inhalation.
Source: Hall, Jr. John R. NFPA Fire Analysis & Research, Quincy, MA. “Burns, Toxic Gases, and other Hazards”.

Visibility: 47% of survivors caught in a fire could not see more than 12 feet (3.6 m).
Source: NFPA Fire Protection Handbook, 18th Ed. Table 1-1P. Pg.1-15.

Approximately 57% of people killed in fires are not in the room of the fire’s origin.
Source: NFPA Fire Protection Handbook, 18th Ed. Table 8-1P. Pg. 8-17.
What is the leading killer in fires?

Smoke & Toxic Gases
How Fast Does Smoke Travel?

Consider this:

- A square room 20 ft x 20 ft x 20 ft has a pencil hole between compartments.
- How long will it take for the smoke to fill the room to a thickness such that you cannot see your hands 18 inches in front of you?
Smoke travels **120-420 feet per minute (36 – 128 m/min)**, under fire conditions.

Source: Estimate based upon ceiling jet velocity calculations for typical ceiling heights and heat release rates.
We can’t rely on any single action or safeguard to keep people safe

The Balanced Approach to Fire Protection
Main Risks in Perimeter Joints:

- Chimney Effect – Internal Spread
- Floor Slab
- 1st Floor
- 2nd Floor
- Curtain Wall
- Ground Floor

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Main Risks in Perimeter Joints:

External Spread – “Leap Frog”

- 3rd Floor
- 2nd Floor
- 1st Floor

- Vision glass
- Spandrel panel (glass, stone, metal...)
- Mullions
- Transoms
Main Risk in Perimeter Joints:

External Spread – “Leap Frog”

*Al Tayer Tower – Sharjah 2012*

*Al Nasser Tower – Doha 2006*
Critical Parts:

1. CW Insulation

2. Firestop Spray

3. Safing Rockwool
Critical Parts:

1. CW Insulation (Leap Frog Effect)
2. Safing Rockwool (Chimney Effect)
3. Firestop Spray (Chimney Effect)
Testing Of Curtain Wall Systems:

- 3 Main Testing Standards:
ASTM E2307

ASTM E2307 – Test Assembly

- View from front face
- Cross-section view

- Test Specimen
- Burner

Back view

Front face
ASTM E2307 – Test Assembly

Curtain Wall Test Assembly

Pre-Burn

Vision Glass

Transom above floor

Mineral wool insulation at spandrel area

Mechanical attachments supporting insulation

Transom below floor

Mullions
ASTM E2307 – Test Assembly

Assembly
Interior View

Pre-Burn

Thermocouples measuring temperature rise
ASTM E2307 – Test Assembly

Video

LSSCWBURN.wmv
ASTM E2307 – Test Assembly

Interior Burner Lit - Time: 0:00
ASTM E2307 – Test Assembly
Exterior Burner Lit - Time: 0:05
ASTM E2307 – Test Assembly

Flames Climbing
Exterior

Time: 0:15
ASTM E2307 – Test Assembly

Melting of Mullions & Transoms

Time: 0:45
ASTM E2307 – Test Assembly

Vision Glass Breaks

Time: 2:00
Burner Off at 2 hours
ASTM E2307 – Test Assembly

Post Test:

Close up Detail of Mullion and Transom Damage
ASTM E2307 – Test Assembly
Post Test – Interior View
ASTM E2307 – Testing Labs

Only two labs presently perform testing in accordance with newly developed ASTM test methods:

Underwriters Laboratories
Northbrook, IL

Intertek
Elmendorf, Texas
Test result: Laboratory listing with very precise construction details

System No. CEJ 308 P (HI/BP 180-02)
PERIMETER FIRE BARRIER SYSTEM - ASTM E 2307

<table>
<thead>
<tr>
<th>RATING</th>
<th>CP 672 SPEED SPRAY</th>
<th>CP 672 FACT CURVE</th>
<th>CP 672 WP</th>
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<tbody>
<tr>
<td>TP-RATING</td>
<td>3-HR</td>
<td>2-HR</td>
<td>1-3/4-HR</td>
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<tr>
<td>L-RATING</td>
<td>1 SFCM</td>
<td>L-RATING</td>
<td>1 SFCM</td>
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<tr>
<td>RATED FOR + 11.25% HORIZONTAL MOVEMENT</td>
<td>RATED FOR + 5% VERTICAL SHEAR MOVEMENT</td>
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</table>

1. CONCRETE FLOOR ASSEMBLY: Three-hour rated concrete floor assembly made from either lightweight or normal weight concrete with a density of 100-180pcf with a min. thickness of 4 in. at the joint face. Overall slab thickness may vary to accommodate various structural designs. Longitudinal expansion joints are formed in the concrete to isolate the architecturally covering slabs. The breakout wall may also vary without restriction.

2. CURTAIN WALL ASSEMBLY: The curtain wall assembly shall incorporate the following construction features:
   - Mounting Attachment: (Not shown) Attachment of the curtain wall framing to the structural framing shall be according to the curtain wall manufacturer's instructions. The distance between mounting attachments shall be 10 ft.
   - Aluminum Framing: Install 1 in. shaped mittens and transoms, sized according to the curtain wall system manufacturer's guidelines. Min. overall dimensions of mitten framing is 0.125 in. thick with a min. height of 5.125 in. and a min. of 2.5 in. width of the mitten. Min. overall dimensions of transom framing is 0.125 in. thick with a min. of 2 in. height and a min. of 2.5 in. width of the transom. Mitten and transom are to be spaced a min. of 36 in. o.c. for the second tier, the lower transoms shall be placed a min. of 21 in. below the concrete floor (as measured from the underside of the floor to the top edge of the transom) and the upper transom shall be placed a min. of 21 in. above the floor as measured from the top surface of the floor to the underside of the transom while maintaining the minimum 46.5 in. transom height.
   - Vision Glass Panels: Glass panels shall be sized and attached according to the curtain wall system manufacturer's guidelines. Use a min. of 0.125 in. clear or heat-strengthened (HS) glass or tempered glass with a min. width and height less than the aluminum framing o.c. spacing, which allows the glass to be secured between the notched shoulder of the aluminum framing and pressure bar. Panels are secured with a thermal break (aluminum extrusion), pressure bar (aluminum extrusion), min. 1/16 x 1/8 in. long screws, and a snap face (aluminum extrusion).
   - Glass Speedi Panel: Glass panels shall be sized and installed according to the curtain wall system manufacturer's guidelines. Use a min. of 0.25 in. clear or heat-strengthened (HS) glass or tempered glass with a min. width and height less than the aluminum framing o.c. spacing, which allows the glass to be secured between the notched shoulder of the aluminum framing and pressure bar. Panels are secured with a thermal break (aluminum extrusion), pressure bar (aluminum extrusion), min. 1/16 x 1/8 in. long screws, and a snap face (aluminum extrusion).
   - Insulation-Framing Angle: Secure a minimum 2 in. x 2 in. 20 GA galvanized steel angle to the underside of the top transom transoms allowing the full length of the transoms between each vertical framing member. Position so that the curtain wall Insulation (CI), when placed flush against the back surface of the angle, is flush with the internal surface of the vertical framing member. Secure the angle to the transom with min. 1 in. No. 10 self-tapping sheet metal screws spaced a minimum 12 in. o.c. Insulation-Framing Angle: Secure the Insulation-Framing Angle to the underside of the transom transoms allowing the full length of the transoms between each vertical framing member. Position so that the curtain wall Insulation (CI), when placed flush against the back surface of the angle, is flush with the internal surface of the vertical framing member. Secure the angle to the transom with min. 1 in. No. 10 self-tapping sheet metal screws spaced a minimum 12 in. o.c. Insulation-Framing Angle: Secure two Insulation-Framing Angles horizontally in the spanned area to reinforce the curtain wall Insulation (CI). The 2 in. leg is placed flush against the exterior surface of the curtain wall Insulation and the 1 in. dimension is positioned on the top of the 2 in. leg, perpendicular to and extended from the Insulation-Framing Angle. Place a minimum of 3 angles in each operated cavity between vertical framing members. Two angles are required to be spaced a max. 4 in. o.c. to the posterior framing region. Diagonally spaced between the Insulation-Framing Angle (CI), the Insulation-Framing Angle (CI) is secured to the wall of the curtain with a minimum of 2 in. No. 10 self-tapping sheet metal screws placed on the horizontal centerline of the framing adjacent to the Insulation, 1/2 in. from each end.
Perimeter Fire Containment - Basic Design Criteria

1. Provide Backing/Reinforcement Member at Safing Line
Reinforcement Member
Perimeter Fire Containment - Basic Design Criteria

1. Provide Backing/Reinforcement Member at Safing Line

2. Mechanically Attached Curtain Wall Insulation
Reinforcement Member

Mechanically Attached Insulation

(hangers, clips, impaling pins, weld pins,...)
Perimeter Fire Containment - Basic Design Criteria

1. Provide Backing/Reinforcement Member at Safing Line

2. Mechanically Attached Curtain Wall Insulation

3. Compression-fit Safing Insulation - as required per tested assembly
   Install Safing Impaling Clips - as required per tested assembly
Reinforcement Member

1. Mechanically Attached Insulation

2. Compression Fit Safing (Direction of Safing as required per tested assembly)

3. & Safing Clips (as required per tested assembly)
Compression Fit Safing (Direction of Safing as required per tested assembly)

Safing Clips (as required per tested assembly)
Perimeter Fire Containment - Basic Design Criteria

1. Provide Backing/Reinforcement Member at Safing Line

2. Mechanically Attached Curtain Wall Insulation

3. Compression-fit Safing Insulation - as required per tested assembly
   - Install Safing Impaling Clips - as required per tested assembly

4. Protect Aluminum Mullions
1. Reinforcement Member

2. Mechanically Attached Insulation

3. Compression Fit Safing
   (Direction of Safing as required per tested assembly)
   & Safing Clips
   (as required per tested assembly)

4. Protect Mullions
Perimeter Fire Containment - Basic Design Criteria

1. Provide Backing/Reinforcement Member at Safing Line

2. Mechanically Attached Curtain Wall Insulation

3. Compression-fit Safing Insulation - as required per tested assembly
   Install Safing Impaling Clips - as required per tested assembly

4. Protect Aluminum Mullions

5. For “Smoke Containment” - Add Firestop Coating
Reinforcement Member

Mechanically Attached Insulation

Protect Mullions

Compression Fit Safing (Direction of Safing as required per tested assembly) & Safing Clips (as required per tested assembly)

Firestop Coating
Firestop Coating
Incorrect Installations:

Traditional Method – 6mm sheet metal top and bottom, filled with mineral wool:

General Value Proposition

Can be valid when

- All voids closed with Fire and Acoustic sealant

Key Weaknesses

- No movement capabilities
- High Load
- Slow to install
- Not tested
Incorrect Installations:

- Incorrect installation of foil boards leaves space for smoke and flames to pass through and may fall out.
- Foil may be damaged very easily.
Incorrect Installations:

Coated boards are ridged and do not allow movement
Overlapping:

- Mastic spray
- Floor Slab
- Curtain Wall
- Firestop expands
- Heat and Flames
- Wall bulges out
Incorrect Installations:

Façade
UAE Fire & Life Safety Code of Practice

2011 Edition
UAE Fire Code requirement:

➢ Classification of Firestop Systems (21.5)

• “21.5.4.3. Perimeter Fire Barrier System ……shall be….in accordance to ASTM E 2307 as the test method (please refer to section 21.16 for acceptable alternative test standards)”

• “21.5.4.4. the firestop system refers to all the necessary components in the approved firestop design, which can include but is not limited to the gap size, backing material depth, sealant depth, and other parameters in the listings”
UAE Fire Code requirement:

- **Installation (21.10)**

  - “21.10.3.4. (joints & CW) …*shall be capable of withstanding anticipated movements* for the installed field conditions… …”

  - “21.10.4.3. (CW ) *Perimeter fire barrier system accessories i.e. metal framing, curtain wall insulation, mechanical attachments, safing materials and Firestop…shall be installed as applicable within the design listed system*”
People with complete trust in the compartmentation

Fire with successful compartmentation
Questions....?
THANK YOU

(Protect Yourself & Others)
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<thead>
<tr>
<th></th>
<th>ASTM 2307</th>
<th>EN 1364-3</th>
<th>EN 1364-4</th>
<th>BS 8414-1</th>
<th>BS 8414-2</th>
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<td>Part</td>
<td>Part</td>
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<tr>
<td>Glazing</td>
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<td>Internal exposure</td>
<td>Curtain Wall, Insulation &amp; Gap Seal</td>
<td>Curtain Wall &amp; Gap Seal</td>
<td>Curtain Wall &amp; Gap seal (partially)</td>
<td>Not Evaluated as a full system</td>
<td>Not Evaluated as a full system</td>
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<td>External Exposure</td>
<td>Curtain Wall, Glazing, insulation or Composite Panel</td>
<td>Curtain Wall</td>
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<td>curtain Wall, Over-cladding &amp; insulation</td>
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<td>Internal OR External Burner</td>
<td>Internal OR External Burner</td>
<td>Internal OR External Burner</td>
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