

Perimeter Fire Containment Systems

ASTM E2307 in CAN/ULC-S115

Presentation Description

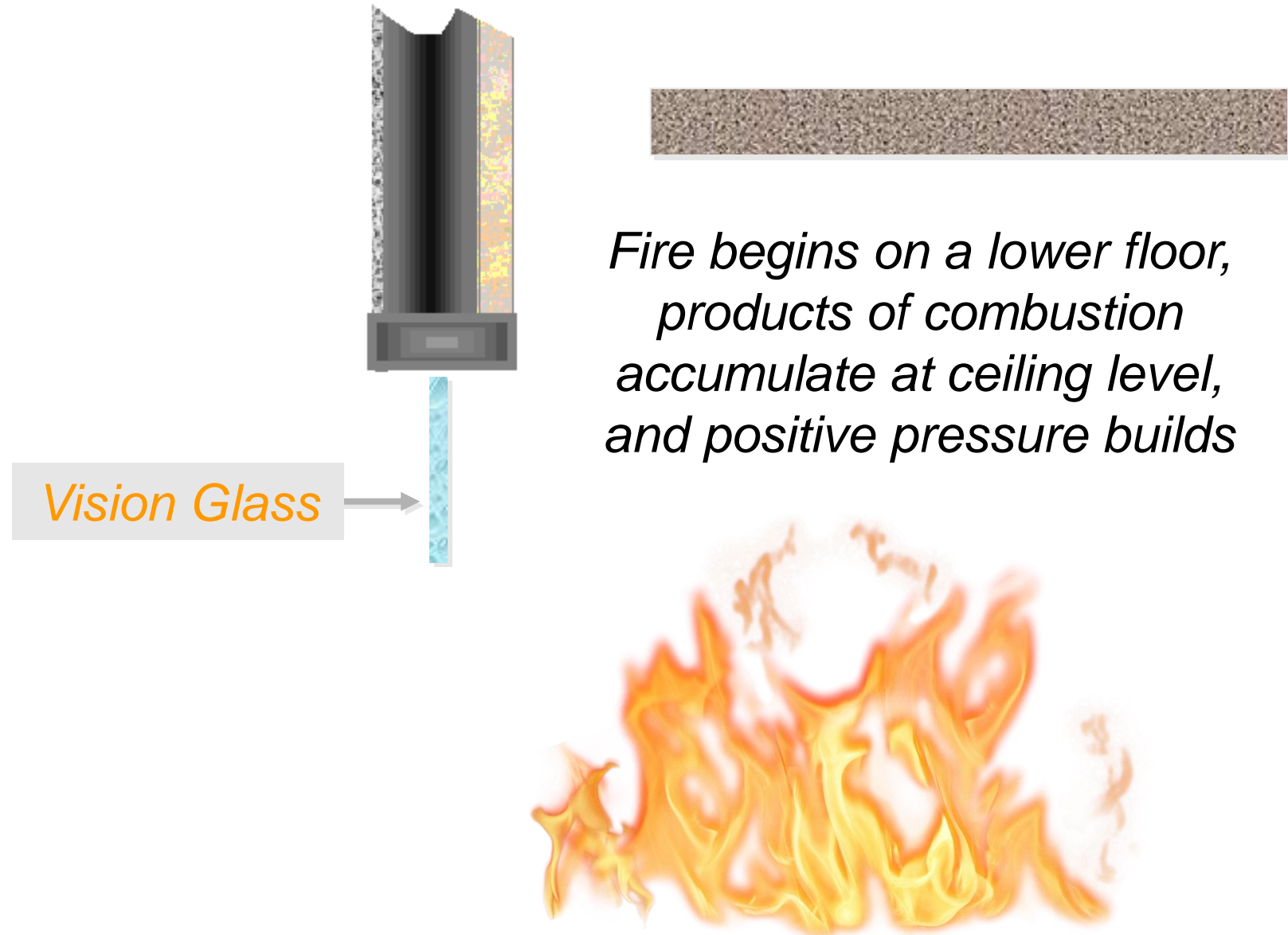
- There has been confusion for many years relating to the interpretation of building code requirements and the application of CAN/ULC-S115 when it comes to perimeter fire containment systems. This presentation explains recent changes made to CAN/ULC S-115 and the requirements for fire resistance continuity of rated floor systems to unrated exterior walls.

Thank you to the International Firestop Council for some slide adaptations in this presentation

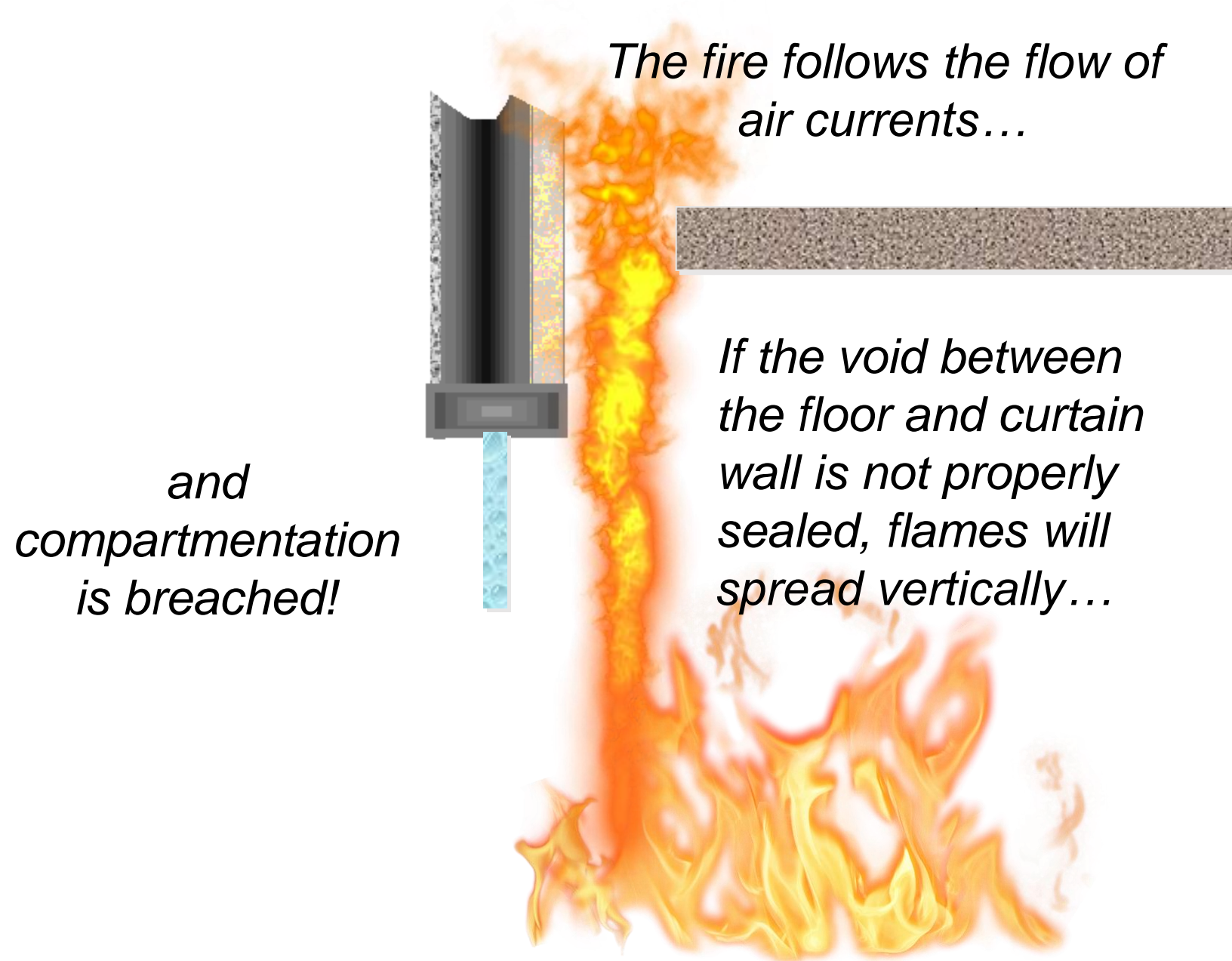


Contextualizing Relevant Fire Test Standards

Rated Floor Assembly and Unrated Curtain Wall



Rated Floor Assembly and Unrated Curtain Wall

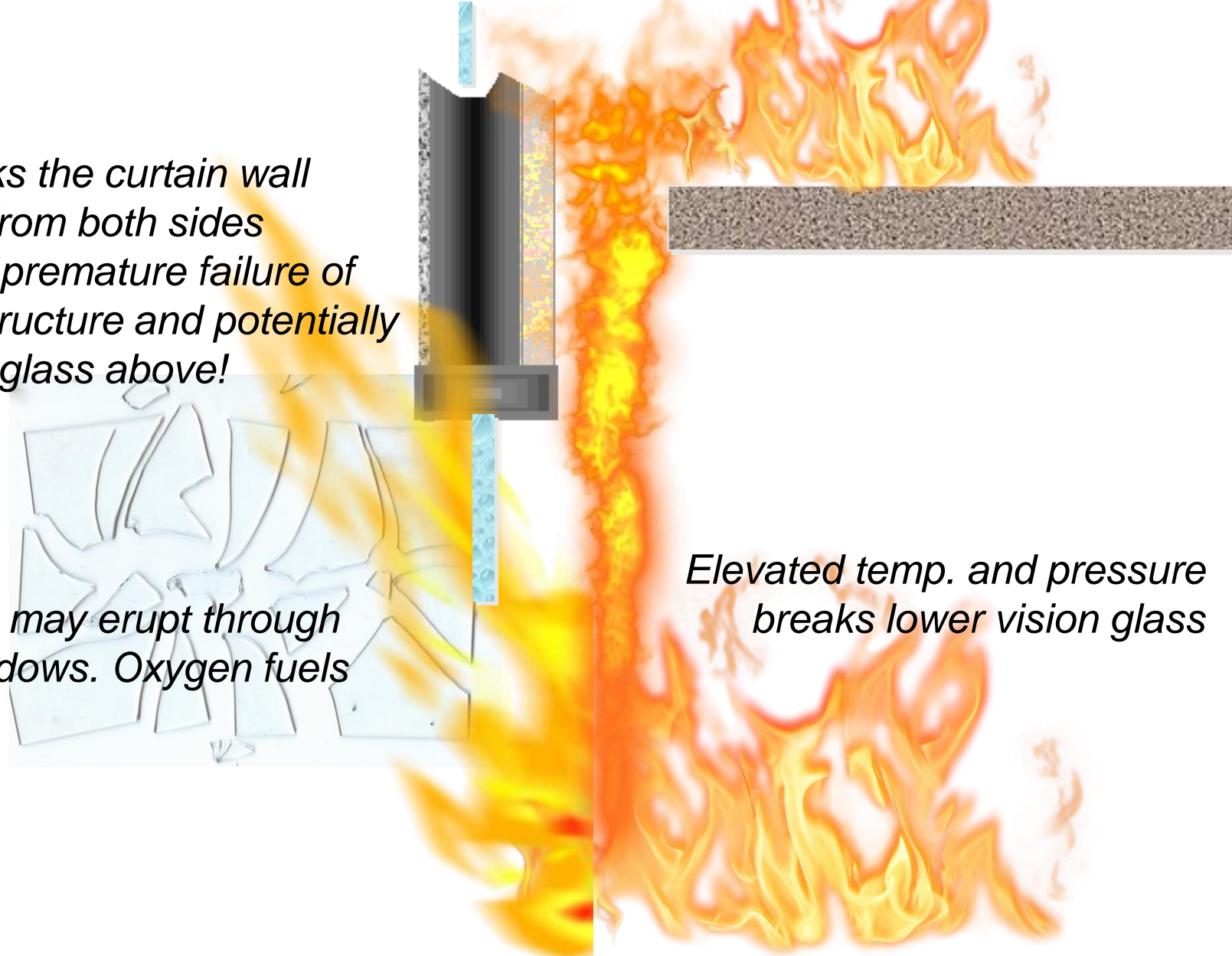


Rated Floor Assembly and Unrated Curtain Wall

Fire attacks the curtain wall structure from both sides causing a premature failure of the wall structure and potentially the vision glass above!

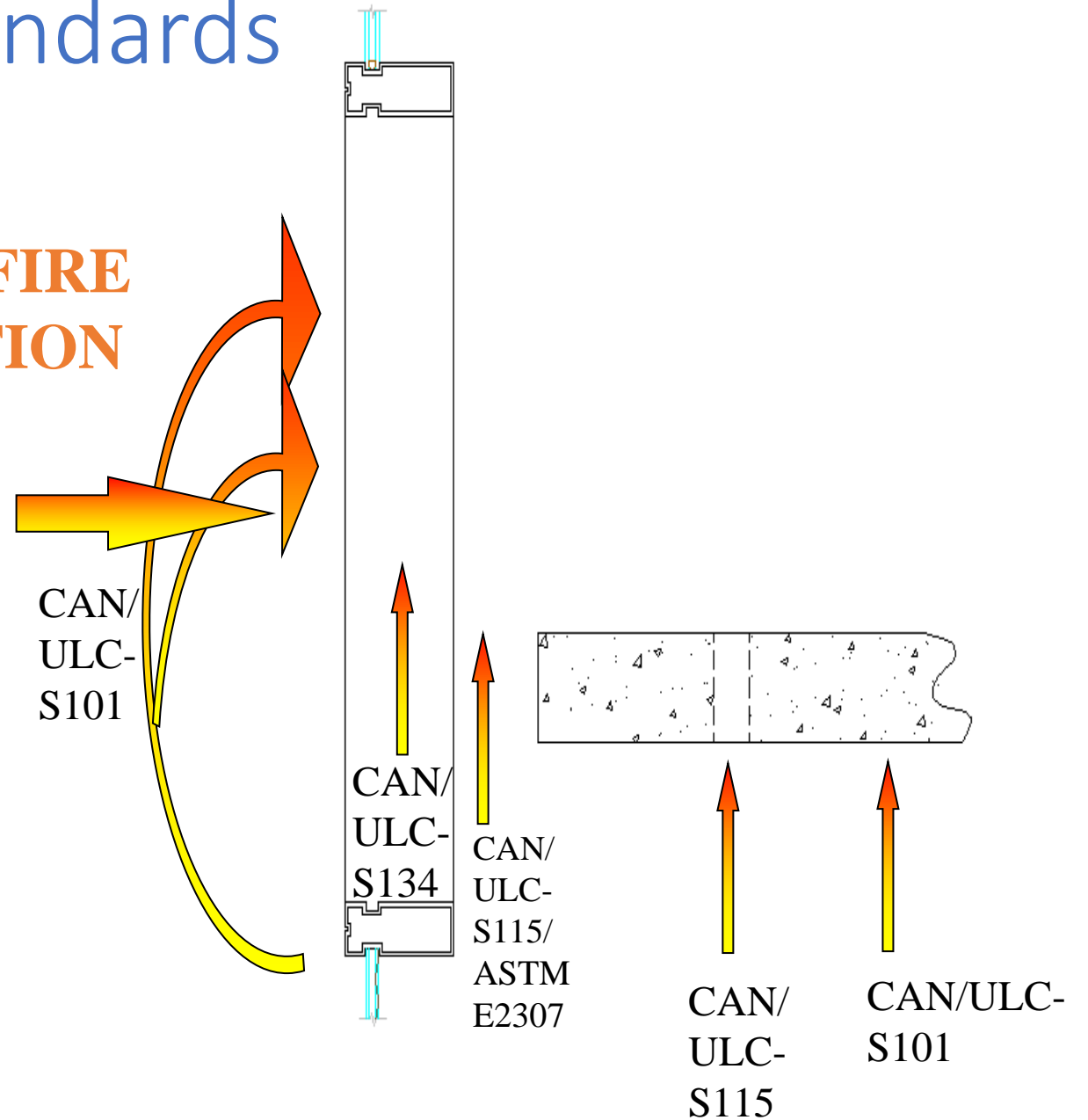
Flames may erupt through the windows. Oxygen fuels the fire.

Elevated temp. and pressure breaks lower vision glass



Exterior Wall Fire Standards

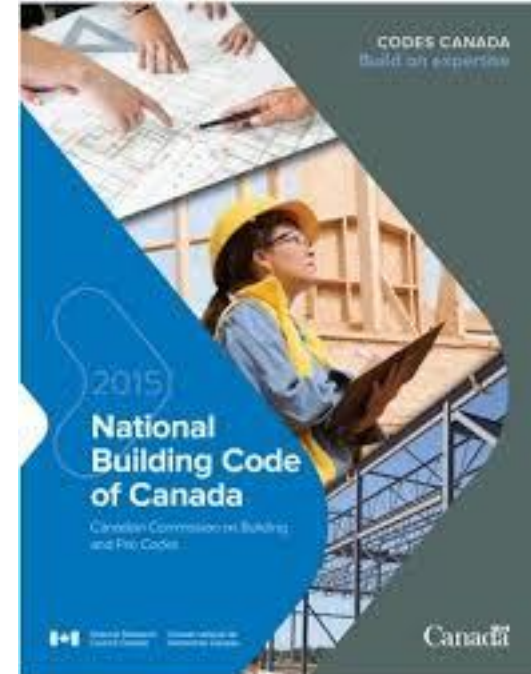
PATHS OF FIRE PROPAGATION



National Building Code of Canada and requirements for curtainwall systems

National Building Code of Canada

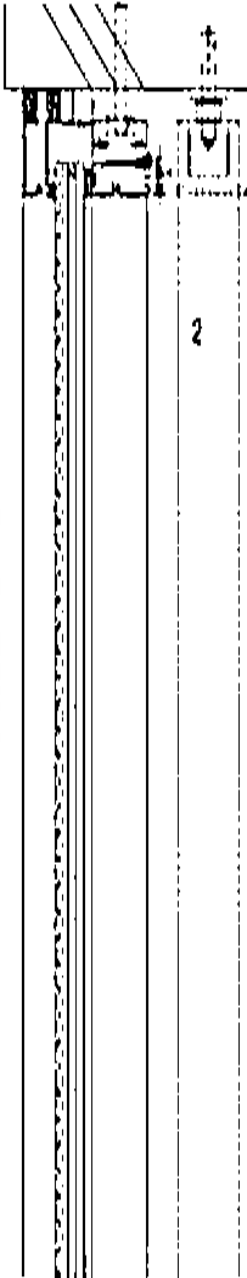
- Continuity of Fire Separations
 - In NBCC, no explicit reference to Joint FS systems
 - However, 3.1.8.1, General Requirement:
 - Any wall, partition or floor assembly required to be a fire separation shall:
 - a) ... be constructed as a continuous element
 - b) ... have a fire resistance rating when specified
 - c) ... have openings protected with *closures*



Mandatory: Extend Fire Resistance to Exterior Wall

In rated construction, all floors are rated

The perimeter joint must be sealed with an approved material or system that extends this rating to the exterior wall surface



Excerpt from Canadian Consulting Engineer Magazine

Unfortunately, the issue that needs to be addressed is how to deal with the gap created with the intersection of a rated floor assembly with a non-rated exterior wall assembly. Firestop joint fire testing per CAN/ULC-S115 always involves the intersection between two fire-resistance rated assemblies. A listed system for a perimeter joint system in compliance with CAN/ULC-S115 therefore is not possible.

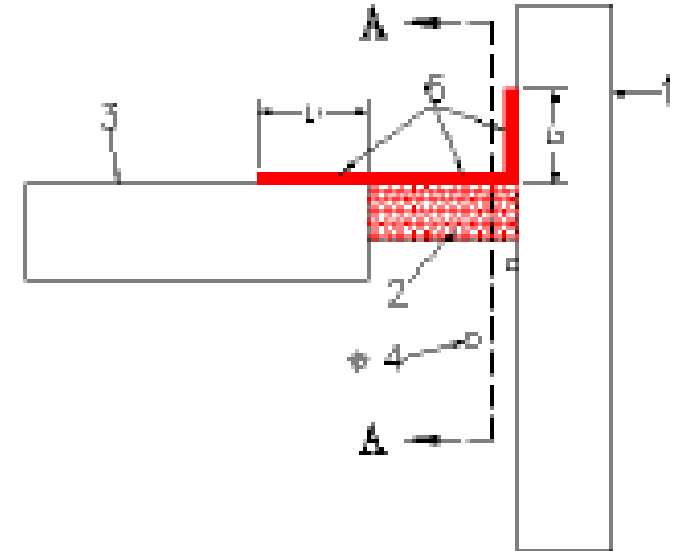
<https://www.canadianconsultingengineer.com/features/firestop-systems/>

Perimeter Barrier Firestops

Firestopping at Slab Edges

Treated as “Joints” per CAN/ULC-S115 until recently

- Most tested as horizontal slab-to-slab systems
- Can/should we use:
 - ULC “PJ” systems (very limited in number)
 - US based Floor-to-Wall type “Listings”



2020 Edition of the National Building Code

- NBC Standing Committee for Fire Protection Reference Standards WG did not get to review the update
- CAN/ULC-S115 will not be updated to the 2018 version until an interim Code will be published
- The following language is expected to be in the next version of the Code

Joints located in a horizontal plane between a floor and an exterior wall shall be sealed by a *firestop* that, when subjected to the fire test method in ASTM E 2307 “Determining Fire Resistance of Perimeter Fire Barrier System Using Intermediate Scale, Multi-Storey Test Apparatus,” has an F rating not less than the *fire-resistance rating* of the horizontal *fire separation*.

CAN/ULC-S115 – what it covers and what has changed

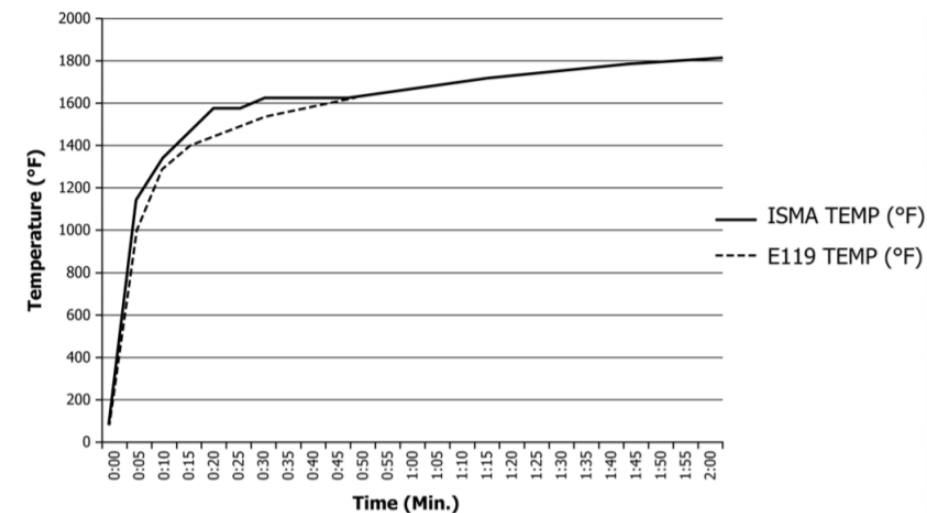
Changes to CAN/ULC-S115

- Previous versions of CAN/ULC-S115 only addressed “joints”
 - Joints between a rated floor and another rated floor
 - Joints between a rated floor and a rated wall
- Joints are still addressed as they were earlier
- There is a new section 9 on Perimeter Joint Firestop Systems
- Clarity that Perimeter Joint Firestop Systems must be tested to ASTM E2307
 - Clarity on the requirement for testing apparatus
 - Must undergo movement cycling as per E2307

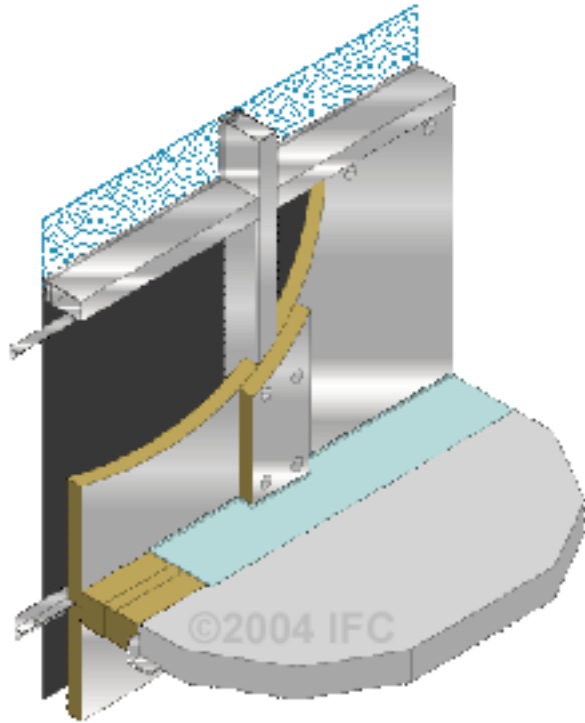
Overview of ASTM E2307

Scope of ASTM E2307

- Fire test method that measures the performance of the perimeter fire barrier
 - ability to maintain a seal to prevent fire spread
 - resisting fire exposure from the interior compartment fire as well as from the flame plume emitted from the window burner below.
- fire exposure is specific to this test method for the first 30 min of then conform to the CAN/ULC-S101 time-temperature curve
- The cyclic movement capabilities of perimeter fire barriers other than the cycling conditions tested.



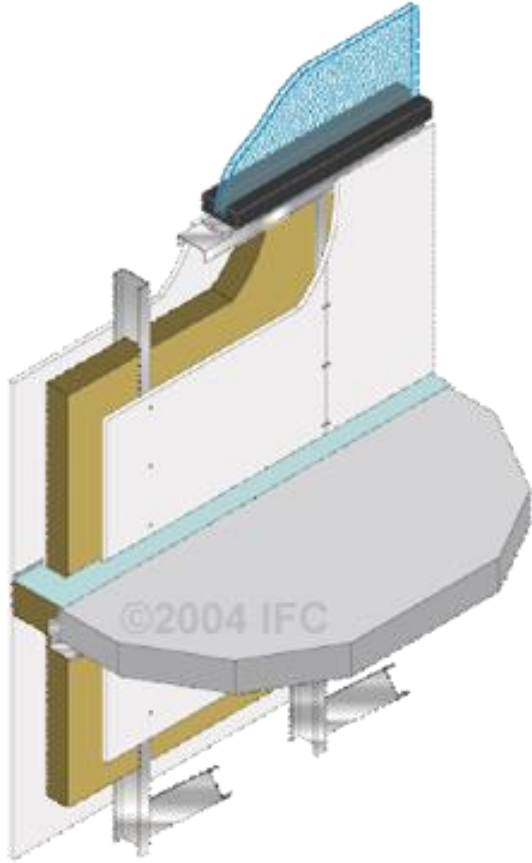
- (1) Window Burner (see 6.3.3)
- (2) Slot in Burner (see 6.3.3.2)
- (3) Gas Supply Line (see 6.3.3.3)
- (4) Perimeter Joint Protection (see 3.2.13)
- (5) Window (see 7.3.9)
- (6) Test Room in Test Apparatus (see 3.2.18)
- (7) Observation Room in Test Apparatus (see 3.2.10)
- (8) Horizontal Centerline of Burner (see 6.3.3.5)
- (9) Vertical Centerline of Burner (see 6.3.3.5)
- (10) Window Burner Location During Test (see 6.3.3.5)
- (11) Exterior Wall Assembly or Calibration Wall (see 7.3 and 9.2)
- (12) Test Apparatus (ISMA) (see 6.2)
- (13) Floor Assembly (see 7.4)
- (14) Floor of Observation Room (see 6.2.4.2)
- (15) Roof Slab (see 6.2.2)
- (16) Floor of Test Room (see 6.2.2)
- (17) Window Sill Height (see 7.3.9.2)



The Perimeter Fire Barrier System...

Slows the process down. Of course it depends on window spacing and other construction factors...

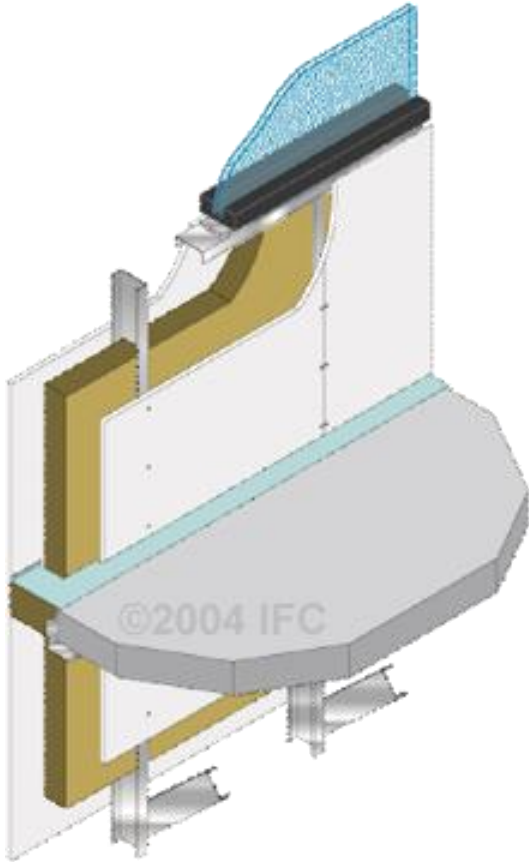
As well as the nature and severity of the fire...



The Perimeter Fire Barrier System...

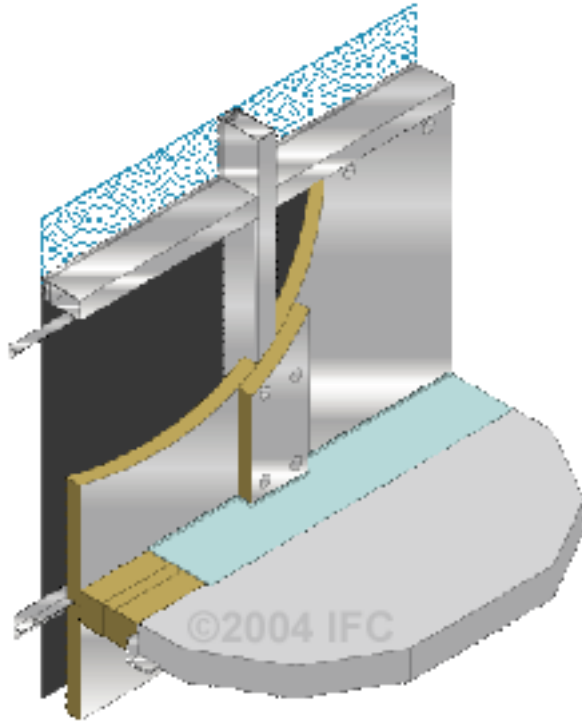
Along with sealing the slot area, a well engineered system provides structural protection and maximizes the integrity of the wall system...

Keeping the wall and window system above intact longer!



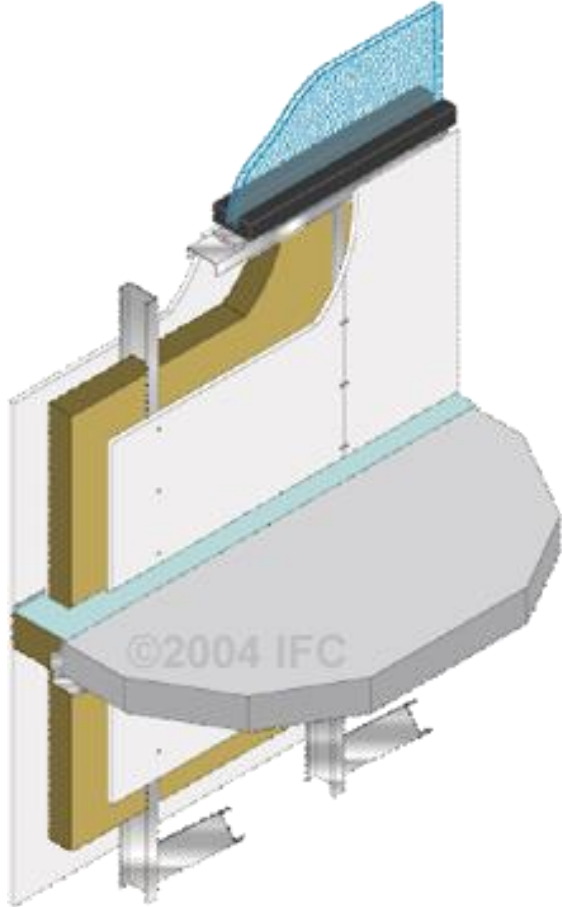
The Perimeter Fire Barrier System...

- Extends the rating of the floor to the wall.
- Forces the fire to exit the building in order to propagate to upper floors.
- Protects structural elements and helps prevent catastrophic failure of the spandrel system.
- Maximizes fire protection afforded by the non-rated wall.



The Perimeter Fire Barrier System...

- Prevents the migration of flame, hot gases and smoke through to floors above.
- Buys time for occupants to escape.
- Buys time for first responders to secure the building
- Provides additional protection in the event of a sprinkler or detection failure.



The Perimeter Fire Barrier System...

Provides energy savings through increased thermal efficiencies throughout the life of the building...

When considered this way, the life safety benefits are free!

Curtain Wall Test Assembly Pre-Burn



Transom above floor

Mineral wool insulation at
spandrel area

Mechanical attachments
supporting insulation

Transom below floor

Mullions

©2004 IFC

Interior Burner Lit - Time: 0:00



Exterior Burner Lit - Time: 0:05



Flames Climbing Exterior

Time: 0:15



Melting of Mullions & Transoms

Time: 0:45



Vision Glass Breaks

Time: 2:00



Burner Off at 2 hours



Post Test:

Close up Detail of
Mullion and Transom
Damage



Post Test – Interior View



ASTM E2307 – Conditions of Acceptance

- “F” Rating—The “F” rating of the perimeter fire barrier shall be determined as the time at which one of the following conditions first occurs:
 - Flame penetration through the perimeter joint protection or around its boundaries
 - The passage of flames or hot gases sufficient to ignite the cotton pad

ASTM E2307 – Conditions of Acceptance

- To obtain the “T” Rating of an assembly
 - The temperature rise of any of the unexposed surface thermocouples on the unexposed face of the perimeter fire barrier 181°C
 - For maximum joint widths greater than 4 in. the average temperature rise cannot exceed 139°C above the initial temperature
 - A correction factor is applied to compensate for deviations in the test exposure from ASTM E119 (CAN/ULC S101)

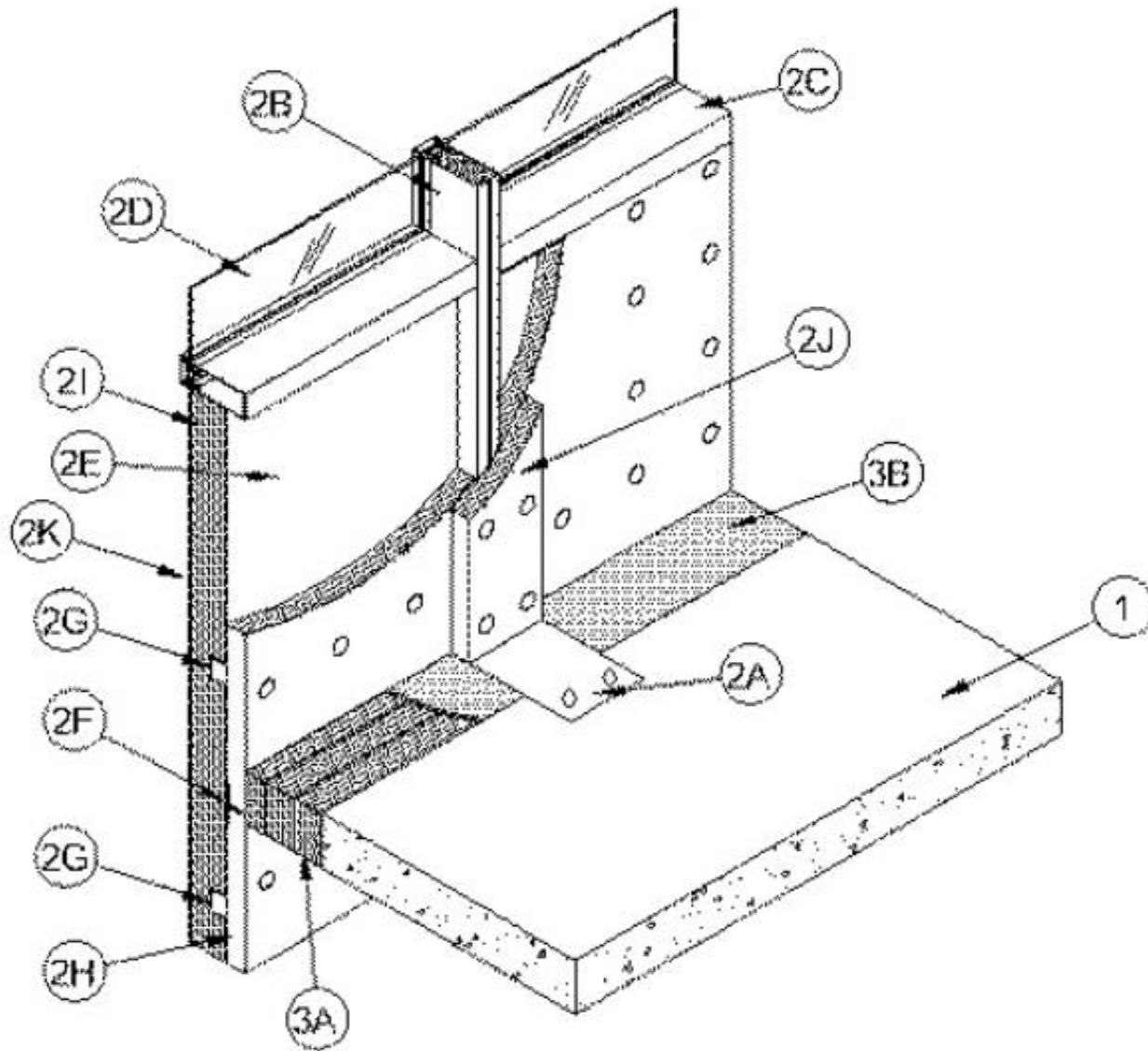
ASTM E2307 – Movement Cycling Requirements

- Movement between the exterior wall and the floor slab during normal building use is expected in most cases
- The test sponsor selects one of the four movement types desired for the movement cycle test
- Install each perimeter joint protection at its nominal joint width
- Examine the perimeter joint protection after movement cycling. Note, photograph, and report any indication of stress, deformation, or fatigue of the test specimen.

TABLE 3 Conditions of Test Specimen Cycling

Movement Type	Minimum Cycling Rates (cpm)	Minimum Number of Movement Cycles
Thermal	1	500
Wind Sway	10	500
Seismic	30	100
Combined	30	100
	followed by:	
	10	400

Understanding Listings



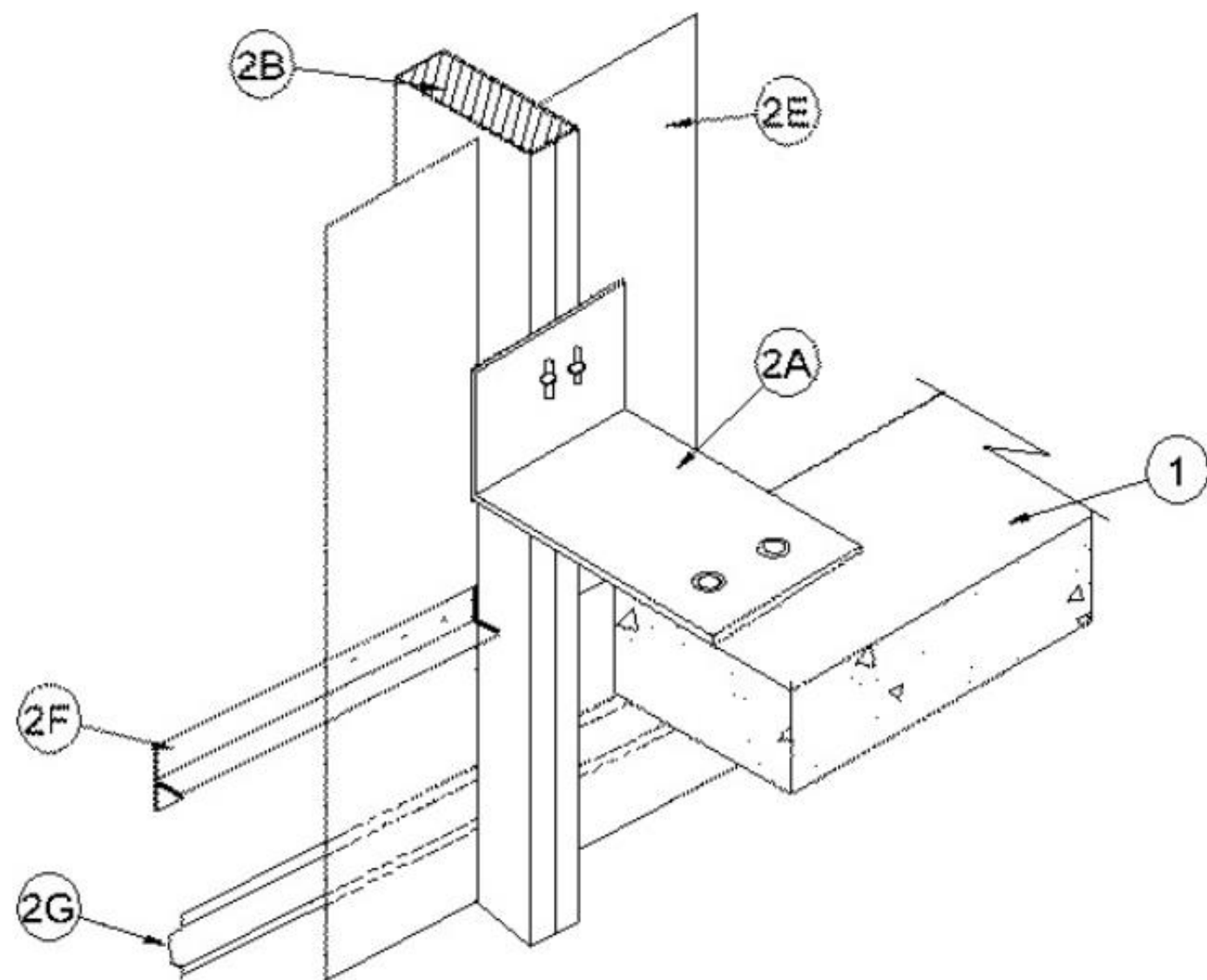
1. Floor Assembly

2. Curtain Wall Assembly

- A. Mullion Mounting Angles
- B. Mullions
- C. Transoms
- D. Vision Panels
- E. Back Pan
- F. Stiffener T
- G. Stiffener Channels
- H. Curtain Wall Insulation — (Interior)
- I. Curtain Wall Insulation* — (Exterior)
- J. Framing Covers - Curtain Wall Insulation*
- K. Spandrel Panels

3. Safing System

- A. Forming Material*
- B. Fill, Void or Cavity Material* - Sealant



Conclusion

- Continuity of the fire separation is required by all Provincial Codes
- The Canadian regulatory framework has not provided much clarity on how to achieve **continuity** of the fire resistance rating of a rated floor and an **unrated** exterior wall
- CAN/ULC-S115 has a new section, providing clear guidance on how to achieved the desired continuity
- CAN/ULC-S115 directly references ASTM E2307 *Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus*
- The upcoming publication of the NBCC will have specific requirements for ASTM E2307
- It is expected that the interim Code will include CAN/ULC-S115
- ASTM E2307 provides a holistic and robust means of establishing the required continuity