Rich Walke Consultant to the FCIA

FCIA VANCOUVER '22

CREATIVE TECHNOLOGY INC. FIRE PROTECTION CONSULTING AND TRAINING

CTT

October 3, 2022





- Two Types of Perimeter Fire Protection
  - Perimeter Fire Containment
    - •Relates to floor-to-floor fire migration
    - Based on Division B, Part 3, Section 3.1.8.3 of the NBC and Sections 708.5 & 715.4 of the IBC
    - Tested to ASTM E2307
  - Vertical Flame Propagation on Exterior of Building
    - •Relates to reaction to fire
    - Based on Division B, Part 3, Section 3.1.5.5 of the NBC, and Chapters 14 (Exterior Walls) and 26 (Plastics) of the IBC
    - •Tested to ULC-S134 or NFPA 285 in Canada and the US, resp.
- Today's discussion relates to Perimeter Fire Containment

# Paths of Fire Propagation



1 – Through void between floor and curtain wall

2 – Window to window "leap-frogging"

# **Classic Fires Where Perimeter Fire Containment Did NOT Work**

- First Interstate Bank, Los Angeles, CA Fire spread from 12<sup>th</sup> to 16<sup>th</sup> floor through improperly protected penetrations and through the perimeter void. One fatality.
- One Meridian Plaza, Philadelphia, PA Fire spread from 22<sup>nd</sup> to 30<sup>th</sup> floor through improperly protected penetrations and through perimeter void. Three fatalities.



# Case Study of the First Interstate Bank Fire



# **First Interstate Bank Fire**

- Building completed in 1973
- Constructed in conformance with the 1960 Edition of the Los Angeles City Building Code
- 62 stories
- Steel deck / concrete floors
- Aluminum framing / glazing curtain walls

- 3 in. void between curtain wall and edge of floor. Void was filled with a noncombustible material.
- Building was being retrofitted with sprinklers but sprinkler were not in service at time of fire
- Building equipped with local fire alarm system

- Fire occurred May 4, 1988
- Approximately 40 people in building at start of fire
- Alarm first sounded at 10:30 PM and was reset at least four times
- Maintenance worker sent up elevator to 12<sup>th</sup> floor at 10:36 PM to investigate. This worker was overcome by flames when door opened and was the sole fatality.

- By 10:37 PM, glazing was falling to ground and flaming was visible on the exterior of the building
- Fire Department notified at 10:37 PM
- Fire Department reached scene at 10:40 PM
- By 11:22 PM fire had fully involved the 12<sup>th</sup> and 13<sup>th</sup> floors, and was attacking the exterior of the 14<sup>th</sup> floor

- By midnight, fire had fully involved the 12<sup>th</sup> through 14<sup>th</sup> floors, with limited flaming on the 15<sup>th</sup> floor
- By 1:30 AM fire had fully involved the 15<sup>th</sup> floor and was threatening the 16<sup>th</sup> floor. Localized flaming did occur on the 16<sup>th</sup> floor but was extinguished.
- Fire declared "knocked down" at 2:19 AM

- During the fire, falling glazing represented a significant hazard to firefighters
- Significant flame extension was observed out the curtain wall during the fire
- Firefighters reported flaming through the perimeter void between the floor slab edge and the curtain wall during the fire

#### **Post Fire Photos**



#### **Post Fire Photos**



#### Lessons Learned

- Confirmed need for automatic extinguishment of fire (i.e. sprinklers)
- Need for monitored alarm
- Need for better protection of void between edge of floor slab and curtain wall
- Need for better protection of penetrations

Redefining Perimeter Fire Containment Requirements

49119	Designation: E 2307 – 04	
	Standard Test Method for Determining Fire Resistance of Systems Using Intermediate-Si Apparatus <sup>1</sup> No mahel to lead eate the field despative 1.20/2 do a regard adoption or, in the case of renders, the year of their render weather calling of Undara as difficult days during the site	f Perimeter Fire Barrier cale, Multi-story Test whe headed blocks to despation before the year of a A starter in presentant blocks to year of her suggered. A minister or macrony
	INTROD	UCTION
	ensistence and assessful and a floor assessful A. A. construction down into shadwards by coher fires two Among in other functions, a perimeter fire benic hefter of origins in the floor(s) shows at the build movement such as those induced by themail affect movement fire benice systems when subjected assessments fire-benice systems when subjected asternation or shows and the star starting of the starting systems (SSM).	Arimitate fire berrier system is a unique building insubiot. insubiot. in system imposes the vertical spread of fire from ing's starturic prelimiter and scownicks versions wearship, submitting, and wind loads, and/of the densities the fire verticance of to standard fire septence conditions using the A). The use of the ambi-story two apparents and this e septence on a perimeter fire between system.
1 Scope 1.1 This was permanent for a permanent for a permanent of the second transmission of the second second transmission of the second transmission of the second transmission of the this test model conforms to be the second transmission of the second transmi	It models measures the performance of the number system and in ability to maintain a seal to searchy and floor assembly during the first seat. The sequents from an interior comparison of the searchy and floor assembly during the first seat. The sead could of the first systems car is in algoing before the first systems car is in algoing before the first scattering car is a segnetar of the base responses car is in the sequence conditions used are those specified by d for the first 50 min of sequences and these sequences conditions used are those specified by d for the first 50 min of sequences and the and criteria for systems carve for random specifies the learning conditions, multi- rate blacks 21 first blacks and thilly of a barriar system to maintain the first resistance the sorthild the performance of perimeter first dramage the systems of a state state that for the second scatter of a first constants 101 as First approach has hill be resulted and that no be	contrast at having downsized the unitality of perimeter for harier systems for use after the sequences. 1.3 This ner method does not provide quantitative informs tion short the perimeter firs burner system during the first parameters balancier of perimeter first horner system during the first perimeters balancier of perimeter first barrier system during the first perimeters balancier of perimeter first barrier system during the first perimeters balancier of perimeter first barrier system during the first perimeters balancier of perimeter first barrier system during the first exception of compliance. 1.6 Foresaming important factors and first characteristics are addressed by this text mached include, but are note limited to constructed with component or during the first barrier system other than they extend, and 1.6 The cyclic movement capabilities of perimeter fir- function of the system of the start and discribe the response of materials, products, or assembles to bate and films under controlled conditions but does not by inal? incorporat life form required for the first-handler of the side in second as the student. The SI values given in periodices are for information only.

# Paths of Fire Propagation



1 – Through void between floor and curtain wall

2 – Window to window "leap-frogging"

# Terminology

- Path 1 Perimeter Fire Containment
  - Alternate terminology
    - •Perimeter Fire Barrier
    - •Perimeter Joint System
    - •Perimeter Firestopping System
    - •Safing Joint System
    - •Curtain Wall System

•Etc.

• Paths 1 & 2 – "Enhanced" Perimeter Fire Containment

A perimeter fire containment system extends the Floor to the Curtain Wall

#### **Required by the CBC & IBC!**



The void <u>must</u> be sealed with an approved material or system that extends to the exterior curtain wall surface

#### "Enhanced" Perimeter Fire Containment

An "enhanced" perimeter fire containment system extends the <u>Floor</u> to the Curtain Wall and prevents flame passage via "leap-frogging"

#### Not Yet Required by the Codes



The void <u>must</u> be sealed with an approved material or system that extends to the exterior curtain wall surface and the curtain wall must prevent "leap-frogging"

Canadian Building Code Requirements



## **NBC Requirements**

- Division 3, Part 3, Section 3.1.8.3 Continuity of Fire Separations
  - 4) Except as provided in Sentence (5), 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 E2307, "Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-storey Test Apparatus," has an F rating not less than the *fire-resistance rating* of the horizontal *fire separation*.
- New for the 2020 NBC
- Consistent with US based requirements

# **NBC Requirements Cont.**

- This new NBC requirement was initiated in conjunction with changes to ULC-S115 in 2018
- 9.1.1 Perimeter Joint Firestop Systems shall be tested in accordance with the requirements in ASTM E2307, Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers using Intermediate-Scale, Multi-Storey Apparatus.

<u>ASTM E2307 Test</u> <u>Method</u>

Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-Story Test Apparatus



#### **Curtain Wall Orientation**



#### **First Floor - Underside of Floor**



#### **First Floor - Underside of Floor**



#### **Second Floor – Top of Floor**



#### **Second Floor – Top of Floor**



# **Conditioning Prior to Fire Test**

Movement Class	Min. No. of Cycles	Min. Cycling Rate (Cycles / Minutes)
Class I (Thermal)	500	1
Class II (Wind Sway)	500	10
Class III (Seismic)	100	30

#### **Time – Temperature Curve**



32

#### **Approximately 2 Minutes**



#### **Approximately 30 Minutes**



#### **Approximately 60 Minutes**



#### **Approximately 120 Minutes**



## **Ratings – Perimeter Fire Containment System**

- F Rating Passage of Flames through Void Only
- T Rating Heat Transmission through Void Only

Both the NBC and the IBC require only an F Rating not less than the fire-resistance rating of the horizontal assembly

# Ratings – "Enhanced" Perimeter Fire Containment Systems

- Integrity Rating Passage of Flames through any Location to Second Floor
- Insulation Rating Passage of Flames through and Heat Transmission at any Location to Second Floor
- L Rating Air Leakage at ambient temperature and 400°F (Optional)

# New Supplemental "Leap-Frog" Test Method

- ASTM E2874 Standard Test Method for Determining the Fire-Test Response Characteristics of a Building Spandrel-Panel Assembly Due to External Spread of Fire
  - Developed based on believe of many that ASTM E2307's focus on interior spread of flame was not sufficient
  - The test structure described in this new standard is similar to that described in ASTM E2307
  - Evaluates the fire performance of an exterior wall assembly for its ability to prevent the spread of fire to the interior of a room one adjacent story above via fire spread on exterior of a building

# New Supplemental "Leap-Frog" Test Method Cont.

- Simulates a post flashover fire exposure within a compartment venting to the exterior of the building and spreading to the floor immediately above via the exterior of the building
- Develops three Ratings on the exterior wall construction
  - •I Rating
    - No flaming on interior surface of the exterior wall construction sufficient to ignite cotton waste
    - •Max 3 kW/m3 heat flux from interior surface of the exterior wall construction

#### •T Rating

 Max 139°C (250°F) average and 181°C (325°F) individual point temperature on interior surface of the exterior wall construction

# New Supplemental "Leap-Frog" Test Method Cont.

•F Rating

•No visible flaming on interior surface of the exterior wall construction

• An attempt was made to introduce a requirement in the IBC for exterior curtain walls based on this method. That proposal was disapproved.

# **Connecting the Dots!**

- Perimeter Fire Containment Systems
  - •As required by the NBC and IBC
  - Tested to ASTM E2307
  - •Establishes F and T Ratings
  - •NBC and IBC require F Rating to be not less than the rating of floor assembly
  - Protects against flame passage through void only
  - •Requires relatively small spandrel height

# **Connecting the Dots Cont.**

- "Enhanced" Perimeter Fire Containment Systems
  - •As originally developed by UL
  - •Uses ASTM E2307 as the basic methodology
  - Expands scope to include flame passage to second floor through any path
  - Establishes Integrity and Insulation Ratings
  - •Not required by the NBC or IBC

# **Connecting the Dots Cont.**

- Protects against:
  - •Flame passage through void
  - •Leap-frogging
- •Requires significant spandrel height to prevent leap-frogging
- "ASTM E2874 "Leap-Frog' Method
  - •Uses ASTM E2307 as the basic methodology
  - Expands scope to include fire performance on exterior wall
  - •Establishes I, T and F Ratings
  - •Not required by the NBC or IBC





# Where Can I Find The Most Current Listing?

- Directories of the Nationally Recognized Testing Laboratories
  - FM Global Approval Guide
  - Intertek Directory of Building Products
  - UL/ULC Product iQ Online Directory



#### Products become systems based on testing!!!

INTERTEK DIREC	TORY OF BUILDING PR	ODUCTS			
Search and view info Product Listings, Co Compliance (COCs), I	ormation on the Directory of I de Compliance Research Repo Quality Assurance, and Indust	Building Prod orts (CCRRs), ry Programs,	ucts, including Certificates of		
Country Nuthing selected					
Company	Nothing selected				
Usting Category	Nothing selected Nothing selected Nothing selected Nothing selected				
CSI Code					
Standard					
Program					
Keywords	1	Spec ID	1		
CCRR #		COC #			
Trade/Brand Name		Design Document			
	Unit results to listings with code compliance research reports (CORRs)				
	C) Limit results to listings with certificates of compliance (CDCs)				
	SEARCH ISSNE				
	SEARCH RESET				

UL Product <b>iQ</b> ®	SEARCH	MY SEARCHES	MY TAGS	RICH 🗘	Solutions
Dashboard / Search / XHEZ7. C-AJ-1755 - Through-penetration Firestop Systems Certified for Canada   UL Product iQ					
XHEZ7. C-AJ-1755 - Through-penetration Firestop Systems Certified for Canada					

# UL Product Categories For Perimeter Fire Containment

- XHDG Perimeter Fire Containment Systems for use in the US
  - Includes approximately 227 individual systems
  - Proprietary products specified in these systems are covered in 3 individual product categories:
    - •Curtain-wall Insulation (XHGU)
    - •Fill, Void or Cavity Materials (XHHW)

•Forming Materials (XHKU)

 Neither UL or ULC has an Perimeter Fire Containment Systems Certified for Canada (i.e. no XHDG7 or XHDGC systems)

# UL Product Categories For Perimeter Fire Containment Cont.

- Reasonable to conclude Perimeter Fire Containment Systems listed for US application will meet the provisions of the Canadian standard and codes
  - Both countries use ASTM E2307
  - Canadian modification to ASTM E2307 make the test more critical than ASTM procedure

#### System No. XHDG.CW-D-2046



#### Anchors



#### **Questions??**





© FCIA 2022

Rich Walke, Consultant to the FCIA Firestop Contractors International Association 4415 W. Harrison St., #540 Hillside, IL 60162 (708) 202-1108

VANCOUVER '22

